ASSESSMENT OF THE EFFECTIVENESS AND FEASIBILITY OF A FEEDER-LINE-HAUL NETWORK IN THE CITY OF MBOMBELA

by

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Project presented in partial fulfilment of the requirements for the degree of Master of Engineering in Transportation in the Faculty of Engineering at Stellenbosch University

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April 2022

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ABSTRACT

The City of Mbombela, although it has not yet reached a metropolitan status, it can be seen that it is rapidly growing towards this status. An integrated public transport system is therefore required not only to improve traveling conditions around the City, but also to address the old apartheid spatial development planning which lead to black communities placed far from the City. The City has seen rapid growth away from the City centre with little or no change to its public transport system.

In general, the city comprises of a composite grid-diametrical network where major routes leading to the City intersect with or terminate at circular ring lines/roads connecting multiple areas along the boundary of the central district. This makes the City ideal for implanting a feeder line-haul system to improve the current public transport system. The project is aimed at investigating the feasibility of implementing a feeder line-haul system in the City of Mbombela. This includes the placing of stations along major routes at the outskirts of the City where mini-bus taxis will act as feeders to these stations and medium sized buses taking over the distribution role.

The current public transport system requires that commuters enter the city centre before reaching their final destinations located outside the City centre. The City is rapidly growing outwards while there has not been any change in the public transport system to accommodate this. During peak hours, the City experiences congestion and majority of the intersections operate at unacceptable level of service. This results in longer travelling times and significantly high travel costs amounting to 20% of low income groups' annual salary spent on travel and up to 2.3 hours per day spent on work trips. The survey confirmed that around 50% of commuters have their destinations outside the City centre

and that around 50% of commuters change vehicles at least once before reaching their final destination.

Intersection analysis found that mini-bus taxis contribute to congestion and poor level of service on intersections along taxi desire lines. It was found that removing taxis from the traffic stream results in reduced delay along lane groups used by taxis. The reduced delay would therefore improve travelling conditions through the City and result in travel time savings.

The study also found that there is a high number of mini-bus taxis operating along the Mbombela-Kanyamazane Corridor which result to a high passenger demand. The estimated peak demand of 1320 passengers per hour per direction, together with demand from the formal bus system, other corridors and attracted car users travelling to the City confirm that a feeder line-haul system is warranted. The study further found that implementation of the proposed feeder-line-haul network would result in reduction in mini-bus taxi fleet and subsequent reduction in operator costs.

The findings of the study can feed into the next level of network or operational design, where detailed modelling of the actual feeder-line-haul network is carried out. This can therefore form part of a future study.

OPSOMMING

Alhoewel die Stad Mbombela nie 'n metropolitaanse status bereik het nie, kan gesien word dat dit vinnig na hierdie status toe groei. ’n Geïntegreerde openbare vervoerstelsel is dus nodig om reisomstandighede rondom die Stad te verbeter. Bykomstig tot bogenoemde is dit ook nodig om die ou apartheid-ruimtelike ontwikkelingsbeplanning aan te spreek, want dit het daartoe gelei dat swart gemeenskappe vêr van die Stad af geplaas is. Die Stad het vinnige groei weg van die middestad gesien met min of geen verandering aan sy openbare vervoerstelsel nie.

Oor die algemeen bestaan die stad uit 'n saamgestelde rooster-diametriese netwerk waar hoofroetes wat na die Stad lei, kruis met of eindig by sirkelvormige ringlyne/paaie wat verskeie gebiede langs die grens van die sentrale distrik verbind. Dit maak die Stad ideaal vir die voorsiening van 'n toevoer-lynkarweistelsel om die huidige openbare vervoerstelsel te verbeter. Die projek is daarop gemik om die uitvoerbaarheid van die implementering van 'n toevoer-lynkarweistelsel in die Stad Mbombela te ondersoek. Dit sluit in die plasing van stasies langs groot roetes aan die buitewyke van die Stad waar minibustaxi's as toevoer na hierdie stasies sal optree en mediumgrootte busse wat die verspreidingsrol oorneem.

Die huidige openbare vervoerstelsel vereis dat pendelaars die middestad binnegaan voordat hulle hul eindbestemmings wat buite die middestad geleë is, bereik. Die Stad groei vinnig na buite terwyl daar geen verandering in die openbare vervoerstelsel was om dit te akkommodeer nie. Gedurende spitstye ervaar die Stad opeenhoping en die meerderheid van die kruisings werk op ‘n onaanvaarbare diensvlak. Dit lei tot langer reistye en aansienlik hoë reiskostes wat neerkom op 20% van lae-inkomstegroepe se jaarlikse salaris wat aan reis bestee word en tot 2,3 uur per dag wat aan werksreise

bestee word. Die opname het bevestig dat die bestemmings van ongeveer 50% van pendelaars buite die middestad geleë is en dat ongeveer 50% van pendelaars ten minste een keer van voertuie verander voordat hulle hul eindbestemming bereik.

Kruisingsontleding het bevind dat minibustaxi's bydra tot opeenhoping en swak diensvlak op kruisings langs die roetes wat die taxi’s verkies. Daar is gevind dat die verwydering van taxi's uit die verkeersstroom lei tot verminderde vertraging langs baangroepe wat deur taxi's gebruik word. Die verminderde vertraging sal dus reistoestande deur die Stad verbeter en reistydbesparings tot gevolg hê.

Die studie het ook bevind dat daar 'n groot aantal minibustaxi's langs die Mbombela-Kanyamazane-korridor werk, wat 'n hoë aanvraag vir passasiers tot gevolg het. Die geraamde piekaanvraag van 1320 passasiers per uur per rigting, tesame met die aanvraag van die formele busstelsel, ander gange en aangetrokke motorgebruikers wat na die Stad reis, bevestig dat 'n toevoer-lynkarweistelsel geregverdig is. Die studie het verder bevind dat die implementering van die voorgestelde toevoer-lynkarweinetwerk sal lei tot vermindering in die vloot van minibustaxi’s en ‘n daaropvolgende vermindering in operateurkoste.

Die bevindinge van die studie kan in die volgende vlak van netwerk- of operasionele ontwerp ingevoer word, waar gedetailleerde modellering van die werklike toevoer-lynkarweinetwerk uitgevoer word. Dit kan dus deel vorm van 'n toekomstige studie.

ACKNOWLEDGEMENTS

The input and information from all the parties that allowed me to make use of their data or software packages for this research is gratefully acknowledged.

My bursar for providing funding and allowing me time to carry out the research.

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CHAPTER 1 INTRODUCTION

1.1 Background information

Mbombela, previously known as Nelspruit, is the capital city of the Mpumalanga Province falling within the Ehlanzeni District Municipality and located in the City of Mbombela (COM) Local Municipality. The City is expected to grow rapidly and heading towards a metropolitan status (*COM Draft IDP, 2019*). Although there are other areas of business importance within the Municipality, majority of businesses are concentrated in Mbombela attracting a high number of communal travel mostly from the eastern part of the municipality where majority of the population is concentrated. These areas include the townships of Kanyamazane (Lekazi), Kabokweni, Tekwane, Matsulu, Msogwaba, Daantjie, Clau-Clau, which, like in many other south African cities, are as a result of past segregation policies that lead to placement of black communities away from the City centre.

The City generally comprises of a Composite Grid-Diametrical Network, where major routes leading to the City intersect with or terminate at circular ring lines or roads connecting multiple areas along the boundary of the central district. The major routes are radial lines terminating or intersecting at the City centre resulting partly into a ring-radial transit network. A composite grid-diametrical network tends to concentrate services towards the centre of a city, while having some degree of parallel grid-like coverage (*Bruun, 2013*).

The challenge experienced is that all public transport enter the City centre during operations resulting in congestion during morning peak hours, while during the afternoon peak, travelers flock into the City centre from their areas of work where they catch a mini-bus taxi or bus to their respective residential areas.

The study was motivated firstly by the longer travelling times incurred by travelers who do not need to enter the City centre i.e, have their final destinations along the City's outskirts, who have to pass through the City centre first. The study was also motivated by the large number of minibus taxis entering the City center resulting in congestion. Considering the concentration of residential areas along the eastern part of the City, a line-haul from routes connecting with the City feeding to substations at strategic locations/nodes may be a cost effective and feasible solution to these problems.

1.2 Purpose of the study

The study aims to achieve the following objectives:

- Understand current travelling conditions - destinations, cost and travel time.
- Assess the contribution of mini-bus taxis to delay and or level of service.
- Estimate the number of minibus taxis during peak hours.
- Estimate passenger demand.
- Consider reduction of mini-bus taxi fleet.

1.3 Problem statement

It can be noted that the City of Mbombela is fast growing in all directions but with very little change or improvement in the public transport system. Passengers having employment along the newly developed outskirts of the City face the challenge of having to pass through the City centre before connecting to their places of work. This phenomenon also holds for those travelling for amenities other than work. Due to the concentration of residential areas on the eastern side of the City, a high volume of mini-bus vehicles is experienced on route towards the City centre resulting in congestion along taxi desire lines.

The aim of the study is to assess the feasibility of implementing sub-stations at strategic locations outside the CBD particularly along major routes. The idea is to have mini-bus taxis feeding to these and medium sized buses taking over the distribution role.

1.4 Significance and motivation

In South Africa, 67% of passengers in the 6 metropolitan areas are carried by mini-bus taxis, making this mode the foremost public transport in South Africa *(SA's Public Transport System, 2014).* On the other hand, *Venter, 2013*, states that the mini-bus taxi industry in South Africa with its current informal mode of ownership and operation, is in the mature phase of its life cycle, i.e, there is not much room for sustainable growth of the industry.

This stresses the great need for transforming and formalising the mini-bus taxi industry. The study also focuses on how mini-bus taxis can be better utilised and integrated with the formal bus system currently operating within the COM Local Municipality.

The compatibility of unscheduled feeder/distributor services and scheduled trunk services has not received much research attention. An investigation of the relationship between unscheduled mini-bus service and scheduled trunk services in Mitchells Plain found that daily operating hours of unscheduled and scheduled services do not match, in that there are complementarity problems between unscheduled feeder/distributer and scheduled trunk services, requiring some form of intervention (*Behrems, Hawver, Birungi, Zuidgeest, 2017*).

1.5 Assumptions and limitations

The study will be focused on one corridor, which is the line-haul between Mbombela and Kanyamazane supported by road D2296 (Kanyamazane Road). This is one of the secondary corridors (*Far Eastern Region Activity Corridor*) consisting of a broad strip of semi-urban and urban settlements. It can be reasonably assumed that the household conditions of public transport users are similar for all the townships, particularly when considering income groups.

The outcome from studying this one corridor can be tested and validated for application to other corridors leading to the City centre. The study also assumes that demand during morning and afternoon peak times is relatively similar.

The study was carried out during the COVID-19 pandemic where certain government regulations that limit travelling were in place. An effort was made to conduct surveys during times when the regulations were relaxed and movement was almost back to normal. The study will therefore consider this limitation.

CHAPTER 2 LITERATURE REVIEW

2.1 Introduction

Public transport plays a significant role in the development of economies of any country with particular regard to access and efficient mobility within a City. The *Draft Revised National White Paper on Transport Policy, 2017* states the policy vision for South African transport as follows:

"A transport system that provides equitable and reliable access for all in an economically and environmentally sustainable manner to advance inclusive growth and competitiveness for the country".

According to the *Department of Cooperative Governance and Traditional Affairs, 2014:15,* in South Africa, many areas continue to be hampered by a legacy of racial segregation, poverty, and exclusion from social and economic opportunities. The spatial legacy is one of sprawl, low densities, functional segregation between home and work, and overlapping racial and class separations

Despite the successful transition to a democratic system, many public transport users in the country continue to experience long travel times and high travel costs in terms of accessing employment, education and other facilities; factors which are essential for sustainable economic and social development, despite various transport interventions undertaken by government. The results of urban sprawl, of poorly integrated public transport systems, and of infrastructure and planning that has historically privileged private cars are to be seen daily on many of the congested South African roads *(Stats SA, 2018).*

Transformation of public transport is therefore required through inter-government cooperation and coordination. This will require the setting of clear public transport indicators such as reduced travel times, reduced costs and to reduce the percentage of household income spent on transport.

It is without a doubt that public transport planning is crucial in realizing the South African policy vision by implementing public transport systems that are accessible, cost effective, time efficient and reliable, safe and secure. It is the objective of this study to investigate, assess and analyse whether implementing a feeder-line-haul network in the City of Mbombela as a measure to improve the existing public transport system is warranted and would provide a benefit.

2.2 The feeder-line-haul system

There are various route networks adopted over many years. These vary from City to City due to geographic elements, spatial development needs and, in many South African cities and towns, due to historic segregation by past laws. The City of Mbombela suffered from past segregation policies which lead to placement of black communities away from the City centre resulting in heavy volume corridors originating mainly from the eastern part of the City from as far as 40 km away.

In general, the City comprises of a composite grid-diametrical network where major routes leading to the City intersect with or terminate at circular ring lines/roads connecting multiple areas along the boundary of the central district. Some of the major routes can be considered as radial lines since they terminate or intersect at the City centre which results partly into a ring-radial transit network. The composite grid-diametrical network tends to concentrate services towards the Centre of a city, yet it also has a degree of parallel grid-like coverage *(Bruun, 2013).*

In the context of this study, a feeder-line-haul network refers to a system where a corridor feeds into a dedicated line that undertakes the distribution role within a City. In simple terms, this system involves the movement of people from their origins along a main corridor towards the City and transferring at a station strategically located along the outskirts of the City to connect to preferred destinations and vice versa. Origins in this context refers to places of residence while destinations refer to places of employment, recreation and other services.

The following figure shows the road network within the City of Mbombela which resembles the composite grid-diametrical network. It should be noted that not all the routes are highlighted for the sake of simplicity. Only the major routes and streets are indicated.

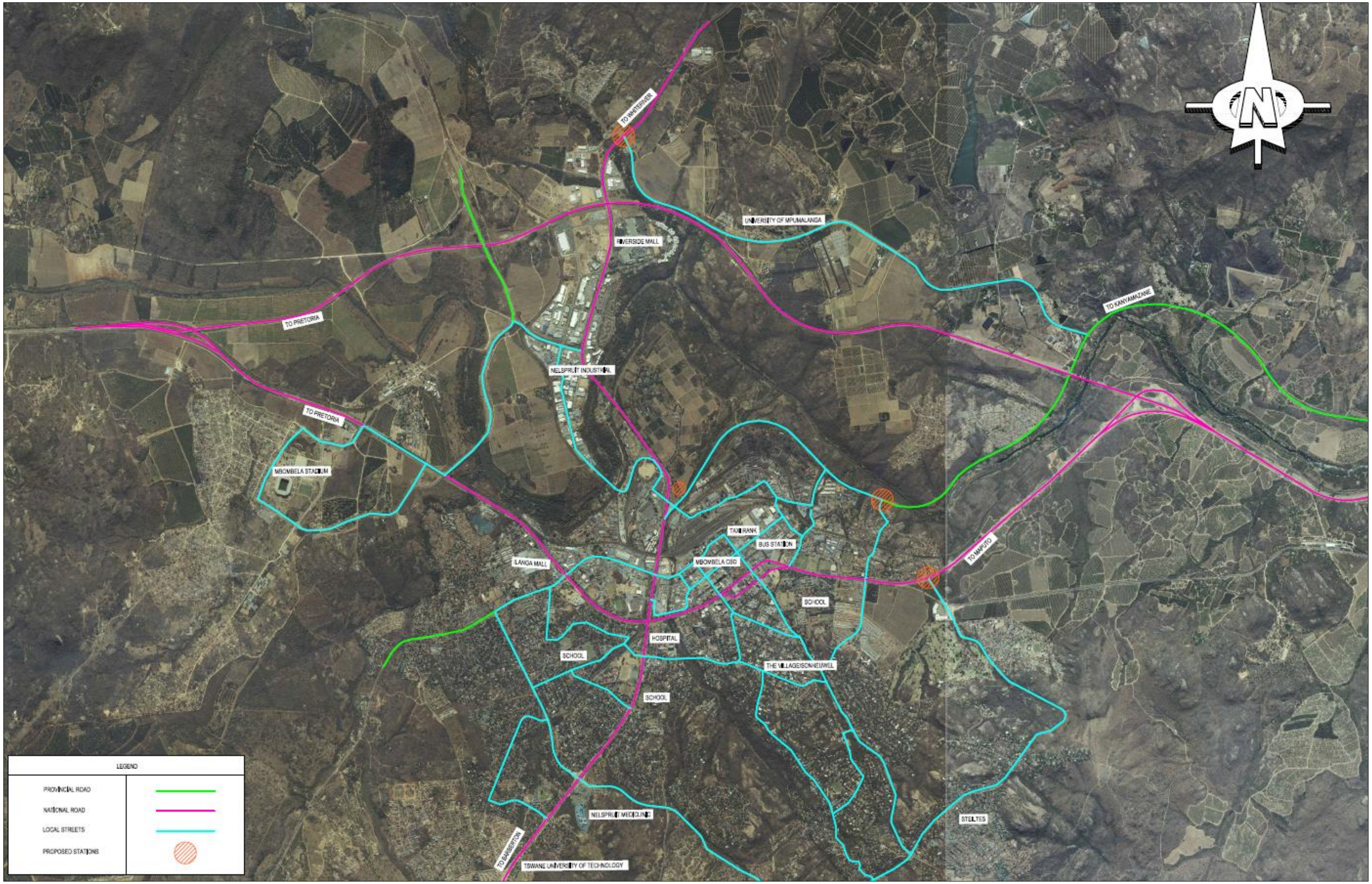


Figure 2.1: Typical road network of City of Mbombela

2.3 Public transport in the City of Mbombela

The main modes of public transport in the City and surrounding areas include bus and para-transit (mini-bus taxi). The bus system is formally operated by *Buscor (Pty) Limited*, while the mini-bus taxis, as it is well known, operate informally without any scheduled times or routes. Information obtained from the bus company shows that 160 000 passengers are transported by this mode daily, operating for the entire day. The bus system covers a number of zones distinguished as local (within the city), Nelspruit suburbs (±40 km radius) and long distance. As of 2014, the company has bus units which include single articulated buses as well as the first 12 new bi-articulated buses ever to be operated in Africa.

In South African major cities, more than 67% of passengers use the taxi mode *(SA's Public Transport System, 2014).* The estimated number of mini-bus taxis in South Africa is around 250 000 (*Business Insider, 2019*). According to the *National Household Travel Survey* of Mpumalanga conducted in 2014, taxis were the most frequently used mode of public transport with 48.3% of households using this mode while 29.5% of households used buses. The study also found that about 11% of workers changed a transport mode on their way to place of work and that taxi users were more likely to make at least more than one modal transfer.

More than half of travellers (57.3%) using bus spend over 60 minutes getting to work while only 20% of those using taxis travel for the same period. In terms of monthly cost of travel, the survey found that it is cheaper to travel by bus (mean = R315) compared to travelling by taxi (mean = R564).

With regards to attitudes and perceptions about public transport in this area, the main problem that households have is that taxis are too expensive and the drivers are reckless. Problems associated with buses included unavailability at specific times or not available at all. The most dominant factors influencing households' choice of mode of travel in Mbombela are travel time (40.4%) and cost (13.3%). Other factors include reliability and safety from accidents. Security was the least mentioned factor (*Stats SA, 2014*).

2.4 City of Mbombela Local Municipality

City of Mbombela Local Municipality (COM) is situated on the north-eastern side of South Africa and falls within Ehlanzeni District Municipality in the Mpumalanga Province. Mbombela (previously known as Nelspruit) is the capital city of the Mpumalanga Province. The City is a major stopover point for tourists travelling to the Kruger National Park and to Mozambique. COM is the fastest growing municipality supporting a population of around 695 000 (*Stats SA, Community survey, 2016*) with an annual growth rate of 2.3% per annum between 2001 and 2011.

COM was the highest contributor to the Province's economy with 22.9% during 2019. According to the *Mpumalanga Provincial Department of Finance, Economic Development and Tourism*, the economy COM has been growing by 1% annually from 2014 to 2018, and it is anticipated that from 2018 to 2023, the annual growth will average 1.7%. The Municipality has major economic activities ranging from trade, agriculture, mining and tourism. Major infrastructure such as the University of Mpumalanga, Mbombela Stadium and Kruger International Airport are found within the Municipality.

One of the spatial strategies of the COM is building a compact, connected, inclusive and vibrant city. This will include an efficient integral movement system such as a line-haul system, strategic road links and bus rapid system. The Municipality consists of two primary corridors namely; the N4 Development and Transportation Corridor (east-west) and the R40 Transportation and Development Corridor (south-north). This indicates that the COM is characterised by four axes of development patterns spread across all regions of the municipality. Movement across Mbombela has been improved by the implementation of the so called “Nelspruit Ring-Road” (west to east), while a north/south new link is in the planning stages.

The following map shows the area within the City where activities are concentrated. It can be seen that, apart from the CBD, there are several areas of interest outside the CBD. There has not been a significant change in the public transport system to accommodate the fast growing outskirts of the City.

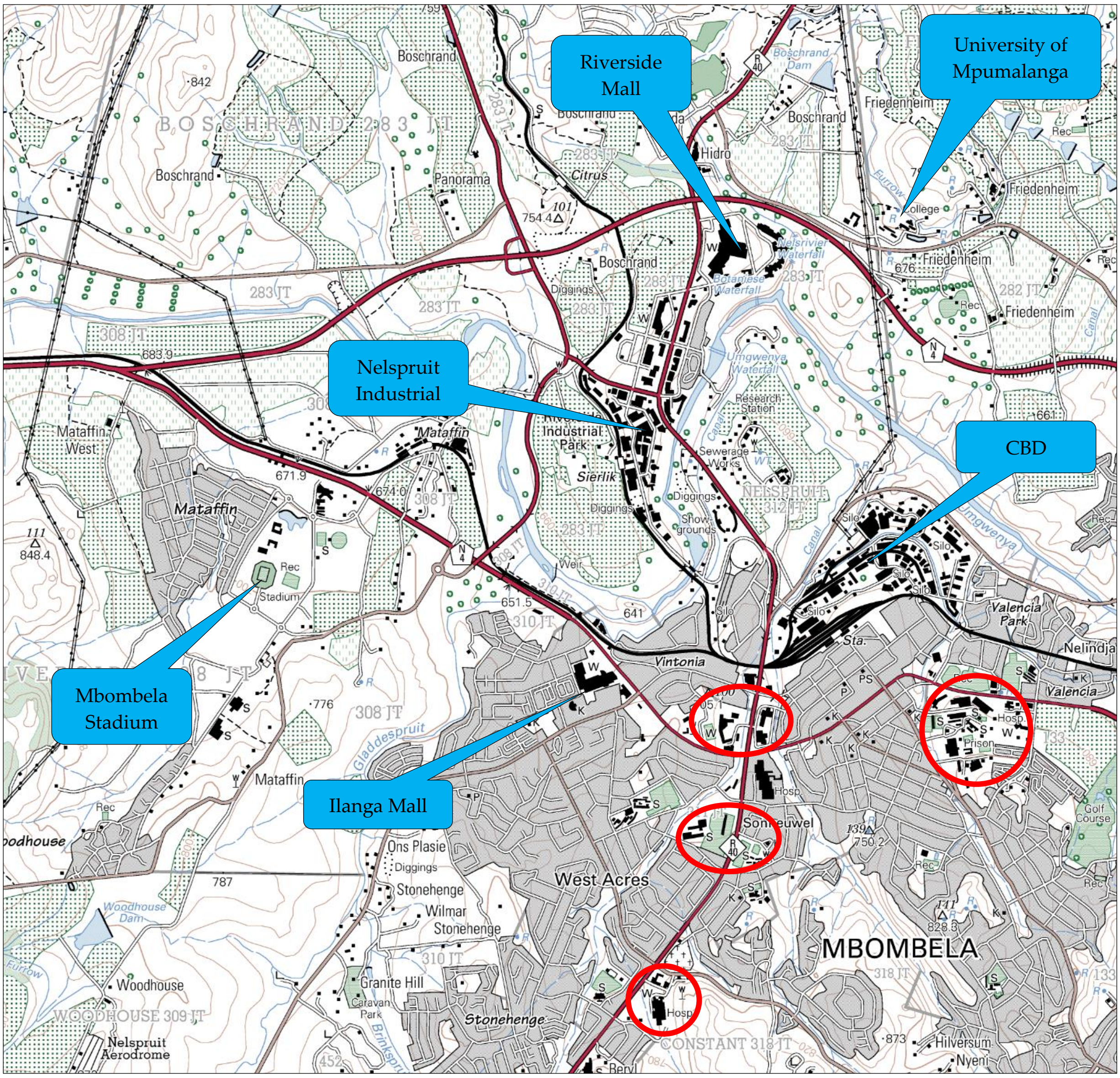


Figure 2.2: Map showing areas of high activity and attractions in the City

2.5 Mbombela Integrated Public Transport Network (IPTN) Programme

In 2017, City of Mbombela presented to the portfolio committee of transport, its Integrated Public Transport Network Programme (IPTN). The City plans, amongst others, to effectively integrate the existing bus and minibus systems on an equitable basis reflective of real relative market share. It is also aimed at responding effectively to the current demand by providing greater travel choices to commuters and maintain scheduled full day services. As a cost effective measure, the programme is aimed at utilising the existing infrastructure and fleets (buses and taxis) as far as possible.

Another critical aspect of the programme is the extension of the feeder services deeper into the semi-rural communities who were placed at considerable distances away from the CBD as result of apartheid spatial planning, which will reduce walking distances and overall travel times. *Figure 2.1* below depicts simple schematics of the old apartheid spatial development plan and the Mbombela spatial development legacy. The envisaged full network is shown in *Figure 2.3.*

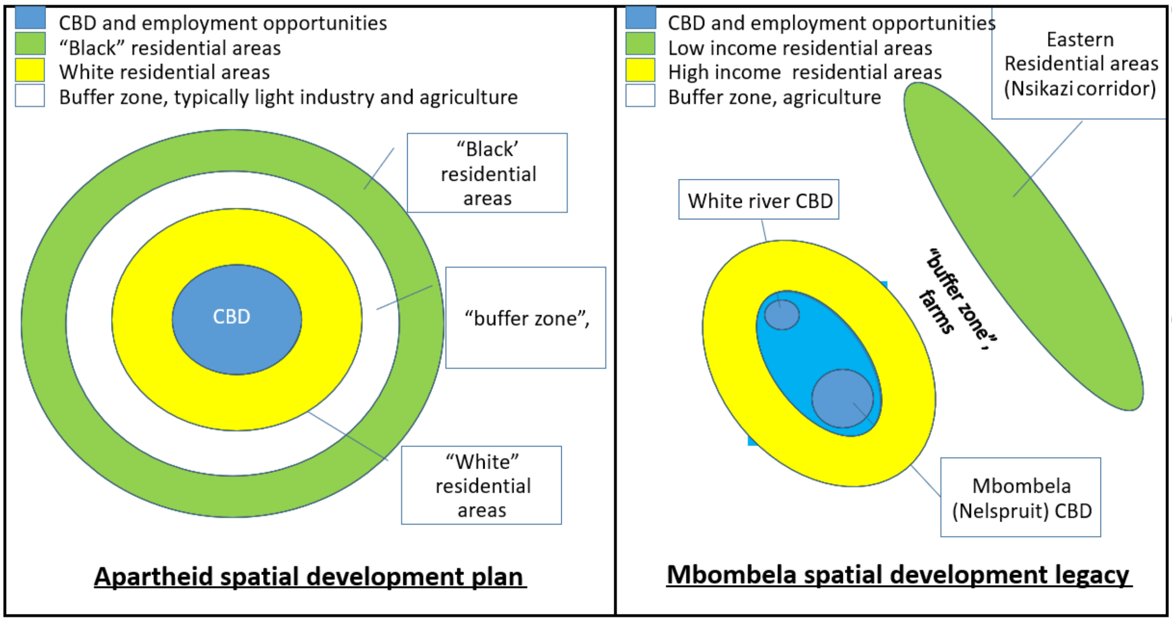


Figure 2.3: Spatial development in in City of Mbombela (Mbombela ITPN, 2017)

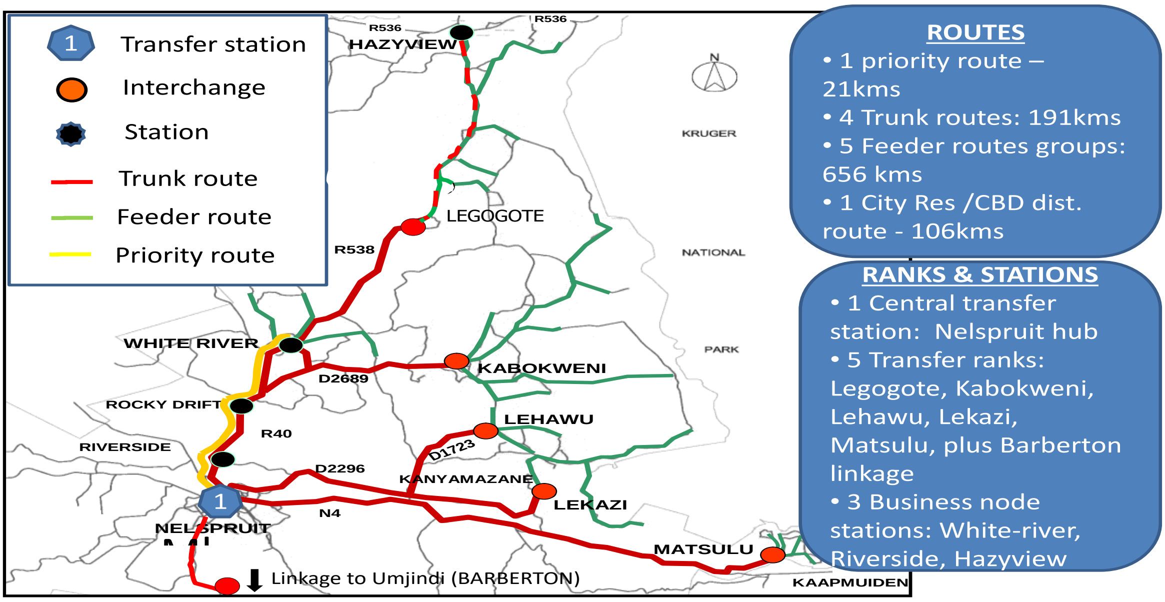


Figure 2.4: Full ITPN plan (Mbombela ITPN, 2017)

The Competition Commission of South Africa reported in its findings from the *Land Based Public Transport Market Inquiry,* that the coexistence of municipal bus services and BRT/IRPTN in certain cities has led to inefficiencies in the form of duplicated infrastructure. The Commission also found that, given challenges and inefficiencies already experienced by Johannesburg, Cape Town and Tshwane, the IRPTN system in its current form is not suitable for smaller cities as they are likely to encounter similar challenges of low passenger numbers. However, "*George is an example of a city that does not have a fully-fledged IRPTN system, but whose network operates cost effectively",* the Commission added.

2.6 Mbombela – Kanyamazane Corridor (Road D2296)

This secondary corridor occurs along Road D2296 (Kanyamazane Road) conveying residents from the major eastern residential areas to Mbombela. Along the corridor are urban residential areas such as Tekwane South, Karino Lifestyle and KaMagugu.

Road D2296, being the preferred route, is a single carriageway road and carries a very high number of vehicles. According to a traffic impact study conducted by *Rhandzo Projects (Pty) Ltd* in 2020, the average daily traffic is over 10000 vehicles per day (both directions). Generally, users of this route are mainly passenger vehicles, buses and taxis. Mini-bus taxis account for around 13% of the traffic while busses account for about 2%. Upgrading of this route to four lanes is under consideration by the Department of Public Works, Roads and Transport.

The corridor is also supported by the National Route 4 (N4), also known as the Maputo Corridor. There is an on-going upgrade of the N4 interchange near Karino which will assist greatly in improving mobility along this corridor. Currently, Road D2296 carries the bulk of the commuter traffic since access to the high speed N4 does not provide safe and efficient access due to topography. The following figure provides a map showing the Mbombela-Kanyamazane corridor.

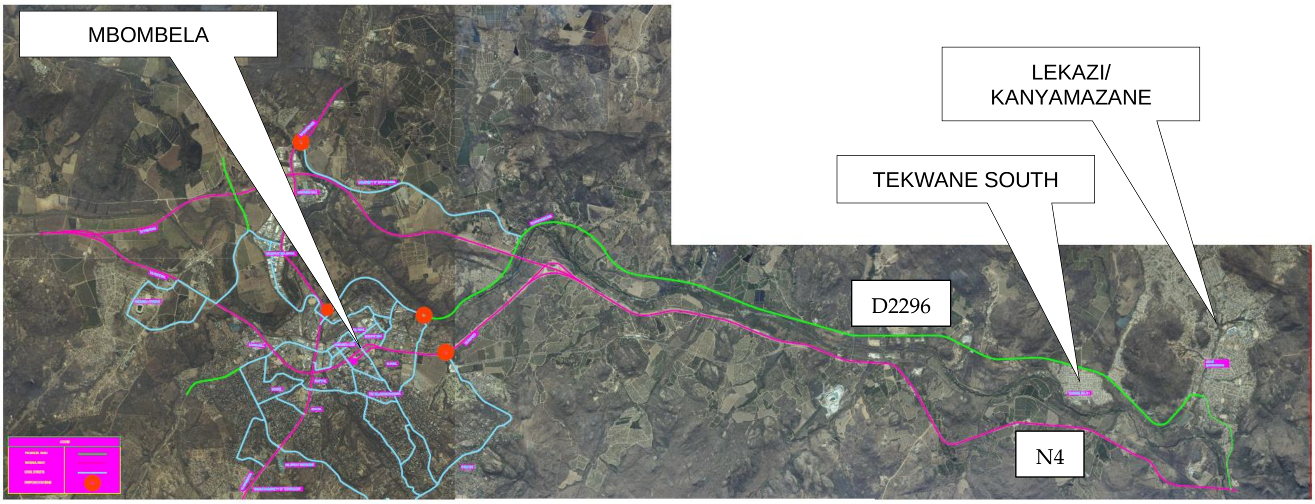


Figure 2.5: Mbombela – Kanyamazane Corridor

2.7 The Taxi industry in South Africa

The industry emerged in the wake of the apartheid government's policy of economic deregulation, which was initiated in 1987. Before this date, operating mini-buses that could carry up to 15 passengers was illegal. Pressure to allow taxis to operate came from black commuters and white business that wanted their workers to be able to travel to work cheaply and more easily. This industry also represents a model of successful black economic self-empowerment and it is the only sector where blacks control an entire sector through their ownership of the taxi mode of transport (*Arrive alive.co.za, 2010).*

The minibus taxi industry is today the most common mode of South Africa's public transport. Not only it is the most available mode of public transport, it is also the most affordable and popular among black commuters for its flexibility and relatively shorter travel times. It is also the only form of transport that penetrates every last sector in cities including the poorest informal settlements. Public transport by taxis account for the majority (more than 60%) of the transport, far more than bus and rail combined. It is estimated to have a turn-over of more than R16.5 billion (*Arrive alive.co.za, 2010).*

Taxis are, on the other hand, well known for operating outside regulatory laws and, as a result, account for a significant number of road crushes and deaths, and taxi wars that have resulted in deaths of many owners, drivers and commuters. The problem in this industry is also exacerbated by ageing fleets, illegal operators and disregard for fleet management.

The government has acknowledged that there is a need to address the problems brought by the industry. As a result, the Taxi Recapitalisation Programme was initiated where government aims to scrap existing unsafe vehicles buy offering an incentive for taxi operators to hand in, on a voluntary basis, the old vehicles for decommissioning. Some taxi associations are said to be for the recapitalisation programme while others disagree with some of the aspects of the programme.

In February 2021, the Minister of Transport indicated that 63 000 taxis will be scrapped in the next three years. He added that the reduction of taxis in the transport system will also emerge from a new public transport system funding model that includes the taxi industry forming part of the integrated public transport networks in ten cities of the country.

This system will result in fewer taxis on the roads, and there are concerns over job losses. However, the system aims to involve taxi drivers as taxi operators or bus maintenance managers. Furthermore, the project includes efforts to integrate a wide range of other services such as feeder vehicles, which will see minibus taxis contributing greatly to the success of the project.

2.8 Integrated public transport system in South Africa

Bus rapid transit (BRT) systems have developed and been implemented in many countries in the world with the first large scale developments in South America. Following the most successful BRT system (*TransMileno Project*) implemented in Bogota, Columbia from the year 2000, many countries began to consider BRT systems for their cities.

The first BRT system in South Africa came to effect in 2009 in Gauteng, linking Soweto to Johannesburg CBD. There are also such systems operating in Cape Town, Pretoria and recently in Durban. A further rollout is earmarked which result in a total of 12 cities and 6 district municipalities in the country.

BRT systems do have their benefits and challenges. The greatest challenge being the ability to attract more customers, particularly private car users, and resistance to the system by the mini-bus taxi industry. In addition to this is the lack of space to construct the required infrastructure. There are a number of social and environmental benefits including reliable service, affordable fares, recapitalisation of the public transport fleet and an enhanced urban environment.

In many south African cities, growth is increasing to suburban areas from the metropolitan area and challenges arise for public transport to increase service to better serve commuters and to integrate suburban service with metropolitan service. Currently, a high number of commuter trips end at the central parts of cities before arriving at the final destination. An integrated public transport system aims to address this, where commuters no longer need to travel via the CBD to reach their final destinations.

2.9 Spatial planning and Economic/Financial analysis

2.9.1 Spatial planning

In South Africa, urban areas are seen as drivers of economic and population growth and points where many social and ecological challenges are concentrated. It is also widely acknowledged that South African urban form is characterised by a number of inefficiencies such as unequal access to economic and social opportunities, poorly located lower income settlements, insufficient public transport and spatial structural elements resulting from apartheid era policies and legislation (*Du Plessis, 2013*).

Spatial Planning and Land Use Management Act (SPLUMA) has the objective to address the above inefficiencies through “Spatial Transformation”. Spatial drivers include greater connectivity through space, integrated transport and mobility, integrated urban infrastructure and efficient land governance and management *(SA CitiesNetwork, 2015).* A feeder-line-haul service offered by the minibuses can play an essential role in aiding this spatial transformation particularly with regards to integrated transport and mobility.

2.10 Economic/Financial analysis

Each transportation system operates within a larger economic, social and physical environment. Network costs include the following:

- User costs – travel time, fares, waiting time, walking distance to the network
- Operator costs – operational costs, rolling stock maintenance, personnel costs, infrastructure costs.

User costs are greatly influenced by level of service (network operations). Higher level of service would normally result in higher fares and infrastructure costs while having reduced waiting times and travelling distances due to improved efficiency. However, fare increase is not popular amongst passengers and government subsidies are almost always required. Passenger demand is therefore critical in that more passengers result in increased revenues and subsequently lower fares and reduced reliance of government subsidy. The taxi industry operates informally with the aim of collecting revenue and avoid incurring operation costs as far as possible.

2.11 Conclusions

The City of Mbombela, although it has not yet reached a metropolitan status, it can be seen that it is rapidly growing towards that status. An integrated public transport system is therefore required not only to improve traveling conditions around the City, but also to address the old apartheid spatial development planning which lead to black communities placed far from the City. The City has seen rapid growth away from the City centre with little or no change to the current public transport system.

Another critical aspect of integrated transport systems is the possible formalisation of the mini-bus taxi industry. The taxi industry is the most critical pillar to the country's public transport sector and government has acknowledge the need to regulate the industry in the best interest of public safety and to transform it into a profitable business. This can be achieved partly by allowing the minibus taxis to operate as feeders into a dedicated line that undertakes the distribution role within the City using medium-sized to large buses.

The City currently has a well functioning formal bus system that, if integrated with mini-bus taxis, can result in an improved and successful transport system. The composite grid-diametrical network found in the City is well suited for the implementation of a feeder line-haul system.

CHAPTER 3 METHODOLOGY AND SURVEY DESIGN

3.1 Methodology

The following is a schematic showing the steps involved in the methodology and survey design.

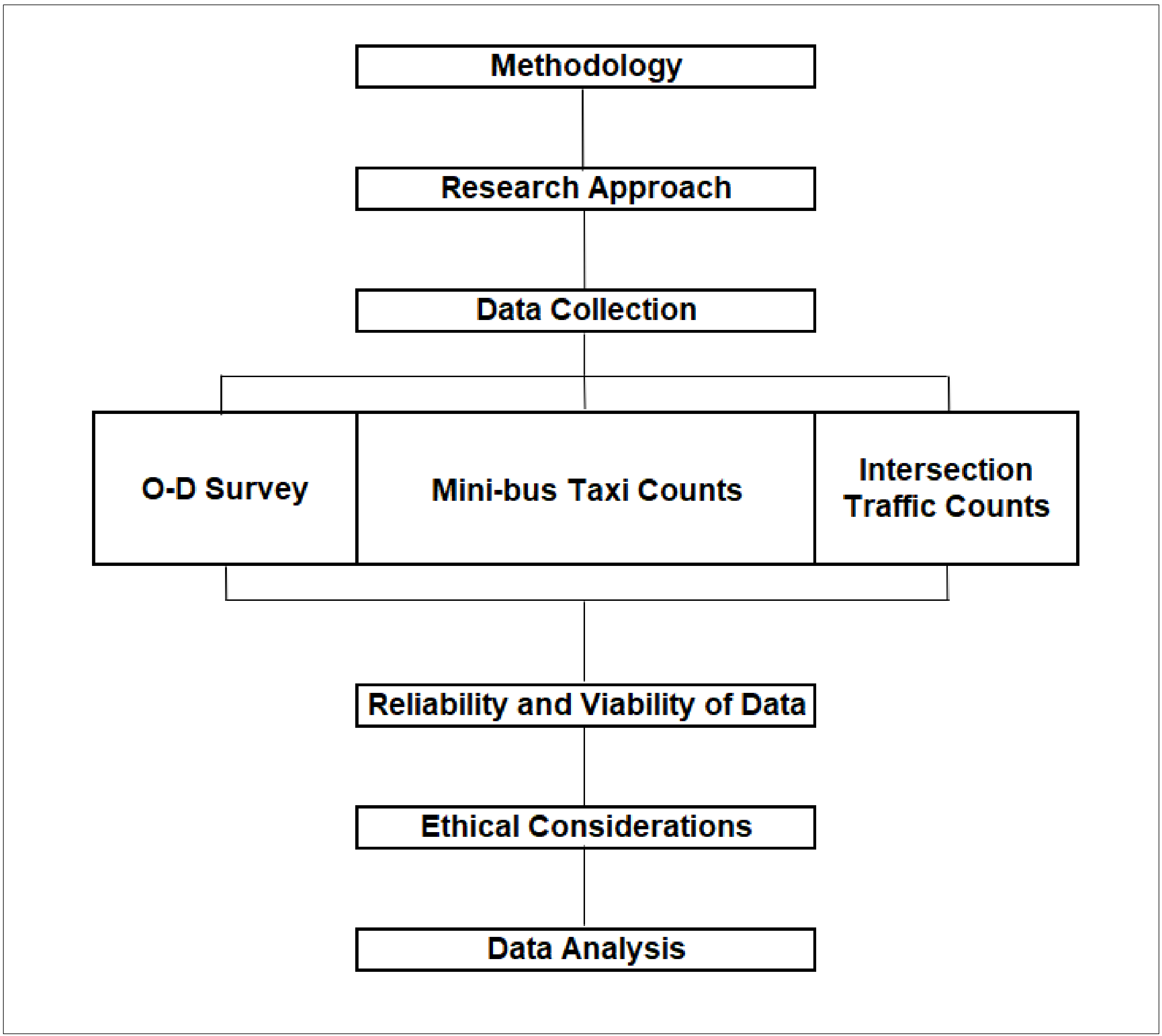


Figure 3.1: Methodology and survey design steps

3.1.1 Research approach

To simplify the study, the focus will be on the Mbombela-Kanyamazane Corridor, which is the line-haul from Mbombela CBD to Lekazi/Kanyamazane supported by Road D2296. It can be reasonably assumed that the household characteristics of public transport users are relatively similar for all the townships, particularly when considering income groups. The solution resulting from investigating one corridor can be tested and validated for application to other corridors.

The line-haul to be considered also connects the majority of the residential areas. In addition to this line-haul, the study will also cover destinations from the CBD to the surrounding places of employment and other amenities that attract people.

3.1.2 Existing general network

A network is defined as the framework of routes within a system of locations, referred to as nodes. A route is then a single link between two nodes that are part of a larger network that can be tangible routes such as roads and rails. Networks tend to have two significant spatial effects on flows, which are centrifugal and centripetal. Centrifugal networks have no specific centrality as no node is significantly more connected than others (grid-like pattern), while centripetal networks have a strong centrality where one or several nodes are much more connected than others (radial pattern) (*Rodrigue, 2020*). The City of Mbombela appears to consist of a combination of the two as shown in the following figure.

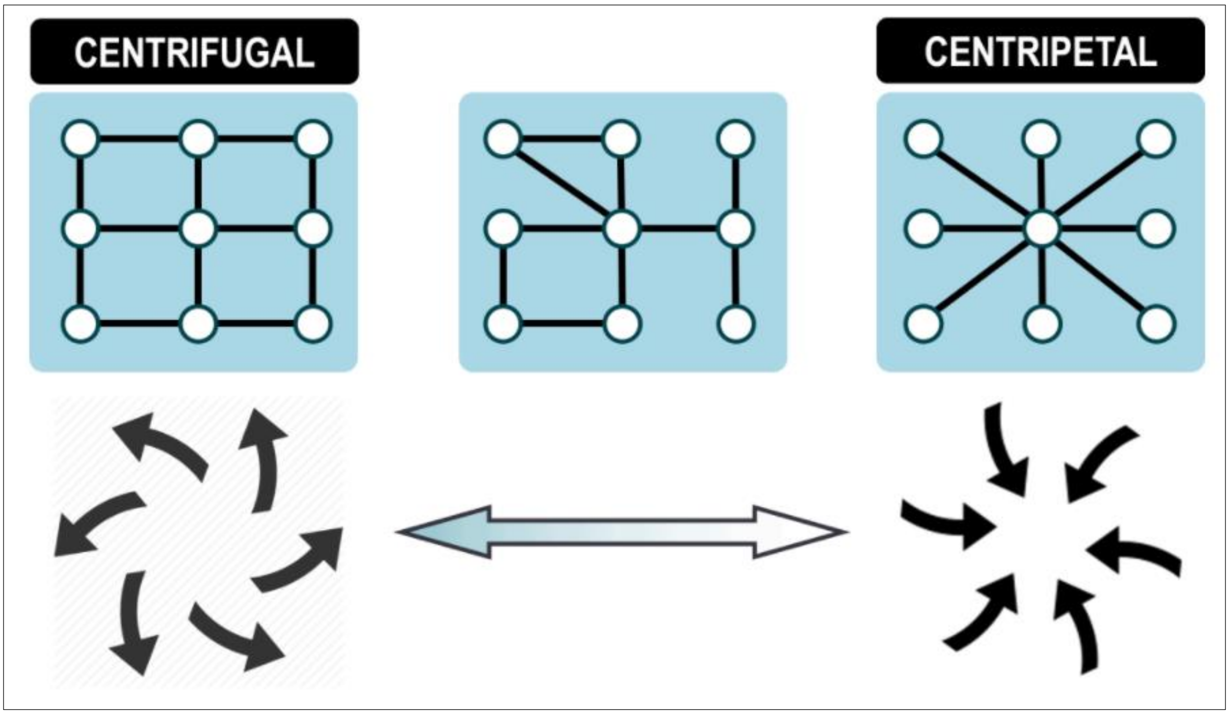


Figure 3.2: Centrifugal vs centripetal networks (Rodrigue, 2000)

According to the *Guidelines for Human Settlement Planning and Design (Red Book),* the network of City of Mbombela can be further classified to exhibit an open and closed network as shown in *Figure 3.3*. A closed network is one that consists of a hierarchy of links, in which links intersect only with other links in the hierarchy while an open network consists of a system of links of differing hierarchical importance intersecting freely with one another. The City consists of a radial multi-directional network which locates neighbourhoods between arterial roads in single land-use components and access is via a curvilinear hierarchical structure. It also seeks to integrate land uses within a network of interconnected streets for all users (*Department of Economic Affairs, 2002*). This function of the City's general network is similar to that defined earlier, i.e, composite grid-diametrical network.

This general classification of the network is further substantiated by the recently implemented first phase of the Nelspruit ring-road supporting the Maputo corridor along National Route 4 (N4) which will be followed by the next phase along the south-north corridor (National Road R40) to separate high speed through traffic from local traffic.

This type of network therefore, promotes increased flexibility in adapting to long-term changes in the function of the roads and the nature of abutting land use activities (*Department of Economic Affairs, 2002*). The research approach is driven by this network which is believed to be suitable for the implementation of a feeder-line-haul system.

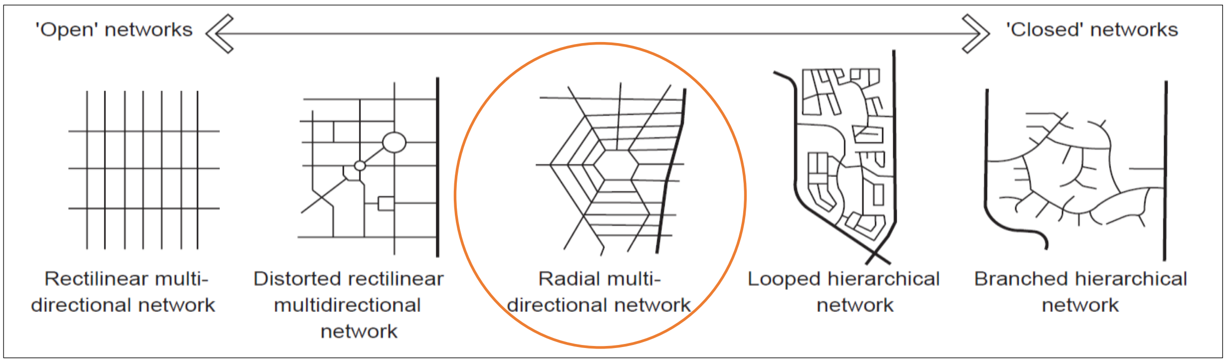


Figure 3.3: Generic network configurations (CSIR, Red Book, 2000)

3.1.3 Data collection

<u>Origin-Destination (O-D) surveys</u>

O-D data collection was carried out through surveys during the months of September and November 2020, where passengers (public transport users) travelling to Mbombela were requested to fill in an online questionnaire regarding their travel details from boarding a vehicle to when they arrive at their final destination or where transferring occurs. The survey questionnaire was created using an online tool (*Kobotoolbox*), which then produced the link that was issued to participants. The sampling size and outcomes are discussed in *Sub-section 3.1.4*.

The prospective participant, following agreement/consent to participate was provided with a link on *Whatsapp* or *Facebook* which lead directly to the online questionnaire. The participant was requested to record time and place of departure, the time and place of arrival and transferring where applicable. Due to covid-19 restrictions which were in place during the time of the survey, there were no face to face interaction with the participants. The data collected did not contain any sensitive personal data. Participants under the age of 18 were not asked to take part in the survey. All information was provided anonymously.

The questionnaire focused on six areas outside the City centre with high economic activity and attraction of people (destinations). Below is a list of the survey questions. The survey questionnaire is attached as *Appendix 1*.

- Reason for travelling (Work, School, Other)?
- Mode of transport (bus/mini-bus taxi)?
- Time of boarding?
- Place of boarding?
- Do you change vehicles along your route, i.e, transfer (yes/no)?
- Time of boarding next vehicle?
- Time of arrival at final destination?
- Please of arrival?

The selected destinations are shown in *Figure 3.4* and the origins are shown *Figure 3.5*.

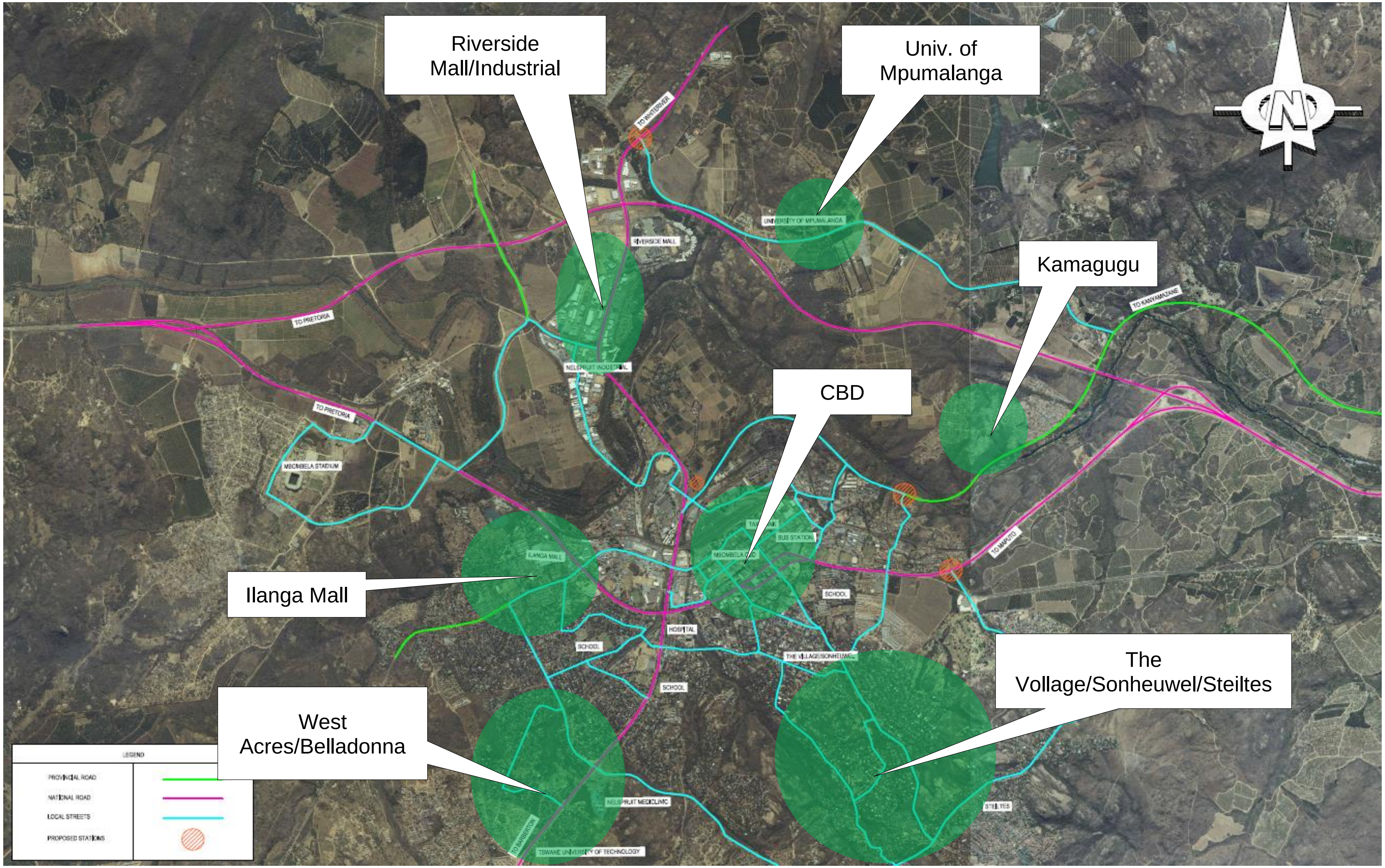


Figure 3.4: Destinations for O-D survey

Mini-bus Taxi counts

Mini-bus taxis running along the study corridor during the morning peak hour (06:00 to 09:00) were counted on 28 January 2021 and 02 February 2021. A stop watch was used to record the time each mini-bus taxi passes (lap) while subsequently recording the headways. The counting was done for two weekdays. It was originally planned that the counts would cover at least three weekdays, however, due to a bridge that was washed away in the area by severe storms (*Cyclone Eloise*), only two days were counted. The data is attached as *Appendix 2*

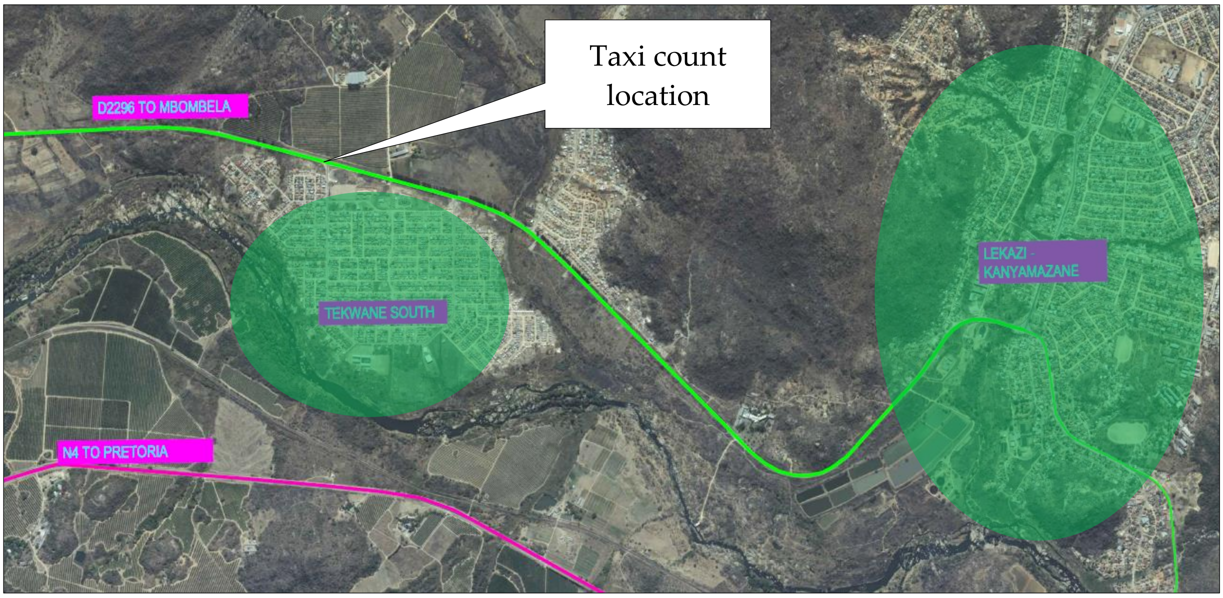


Figure 3.5: Mini-bus taxi count location and origins for O-D survey

Intersection traffic counts

Traffic counts for various intersections within the City was provided *Endecon Ubuntu (Pty) Ltd*, who are responsible for the master plan of the City. The information included peak hour volumes (AM and PM). The counts were carried out before 2021 (2010, 2013, 2014, 2016, 2017, and 2021) and a growth factor 4% was applied to estimate current conditions. The data is attached as *Appendix 3* and the intersection count locations are indicated by the red dots in *Figure 3.6.*

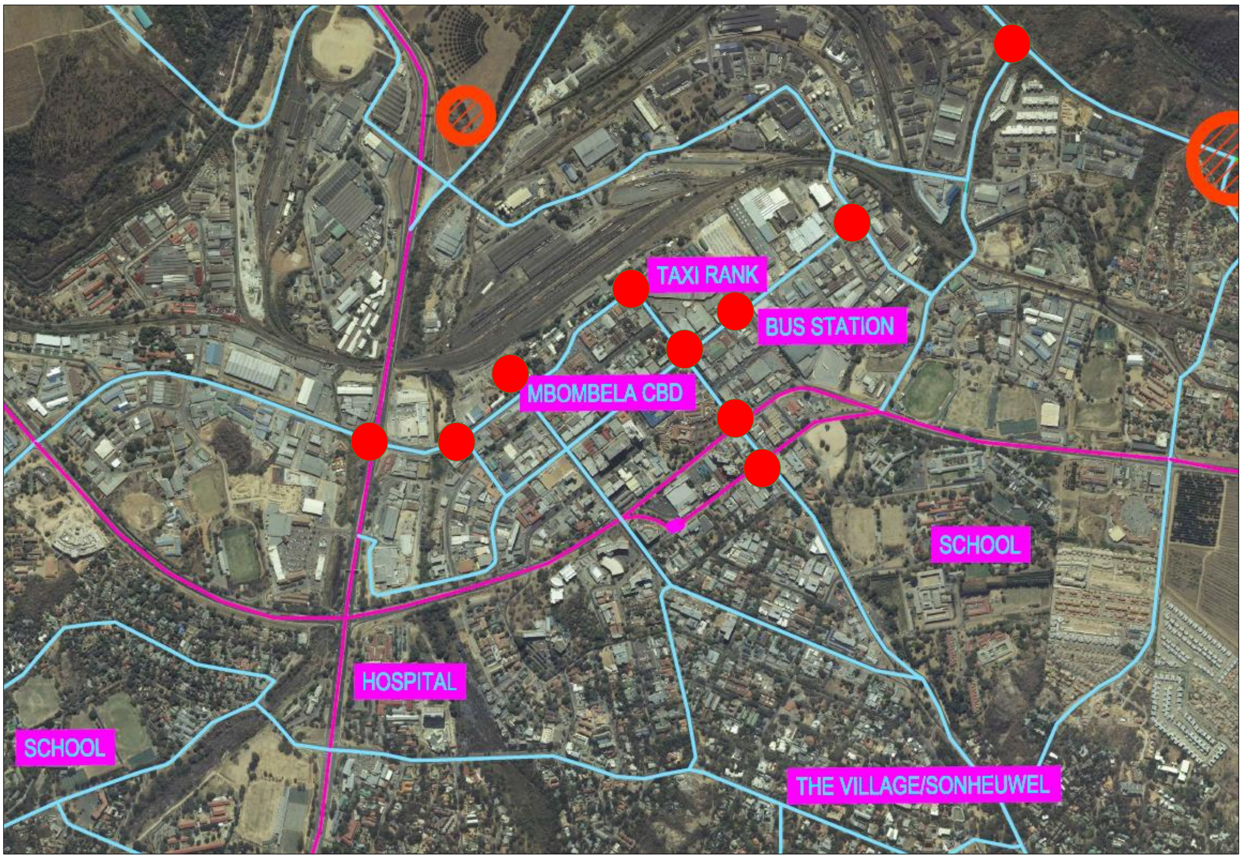


Figure 3.6: Intersection traffic counts locations

3.1.4 Reliability and Validity

<u>O-D survey</u>

The O-D survey, mini-bus taxi counts and one of the intersection counts were carried out during the COVID-19 pandemic, therefore, travelling was affected as some sectors of the economy were not operational or were partially operational. A traffic study carried out by *Innovative Transport Solutions (Pty) Ltd (ITS)* along the R40 corridor (*Contract R.040-050-2020/1F*) showed that during level 3 restrictions, traffic was about 16% less than normal. Considering that this investigation is mainly focused on public transport which was allowed to operate at full capacity during these restrictions, it was assumed that the 16% reduction will not have a huge impact on the analysis.

They were also challenges with the O-D survey. The initially anticipated number of participants was not achieved. It was envisaged that at least 200 participants will be surveyed. In addition to this, some of the participants did not fully complete the questionnaire or populated it incorrectly. The reduced number of respondents may be attributed to the fact that, to complete the survey, a participant needed to have an internet/network connection. Due to COVID-19 restrictions, training of participants was not carried out. It was initially anticipated that the survey would be carried out during a period where restrictions to travel and COVID-19 regulations were lifted. This would have allowed for detailed interaction with prospective participants and participation as well as quality of the data would have improved.

To account for these, the data was scrutinised and errors were corrected. Following further assessment of the data, it was found that inviting more participants would have not provided further benefit due to the type of information required. The thirty-three (33) participants provided sufficient information to meet the project's objective.

<u>Intersection traffic counts</u>

The intersection counts were carried out prior to the year 2021. A reasonable growth rate had to be applied to estimate current traffic flow rates. A growth rate of 4% was found to be acceptable. This rate is supported by other traffic studies done along Road D2296 as reported by *Rhandzo Projects (Pty) Ltd* and along Road R40 as reported by *ITS*. *Endecon Ubuntu* recommended a growth rate of between 2.5% and 3%.

3.1.5 Ethical Considerations

Ethical clearance was granted in accordance with Stellenbosch University's Research Committee requirements. The project investigator was granted permission to source data provided that permission was received from the relevant company and that consent by participant was given. The were no face-to-face interaction with participants as per the institution's COVID-19 requirements at the time.

The O-D survey was structured in a manner that a participant was not required to provide any personal data and that the participant would not be negatively impacted by the survey. People under the age of 18 were not invited to participate. Data provided by organisations were used solely for the purpose of this study and will not be in the position of any other party other that the investigator. The letter of approval from the Ethics Committee is attached as *Appendix 4.*

3.2 Data analysis approach

The data collected represents existing conditions within the study area. These include current public transport conditions, commuter travel patterns and conditions at selected intersections within the City. The analysis aims at assessing the existing conditions in comparison to feeder-line-haul system that can be implemented to improve the existing public transport system.

The principles employed are theoretical concepts drawn from modules that were presented to the project investigator in the field of transportation engineering. These include methodologies from Traffic Engineering Capacities, Traffic Flow Theory, Public Transport and Transportation Planning. For the purpose of this study, the methodologies and theoretical concepts outlined in these modules are applied to assess the feasibility of implementing a system with the aim of improving travel conditions, barring in mind that there may be several other solutions to the perceived problem.

Considering the limitations and assumptions of the study, the outcome is not aimed to benefit any other party but rather to show that the investigator understands the applicability of the relevant theoretical concepts pertaining to the scenario under consideration. In analysing the data, the investigator further applied his experience of the study area, which governed the selection of study routes, corridors, mini-bus taxi desire lines and affected intersections. The *PTV Vistro Traffic Engineering Software* was used as part of the analysis which applies methodologies from the *Highway Capacity Manual, 6th Edition*.

CHAPTER 4 ANALYSIS AND RESULTS DISCUSSION

4.1 Introduction

The O-D and traffic counts provide information to assess the existing travel conditions along Road D2296 and within the City of Mbombela. The current public transport system forces, to some extent, commuters to make stops within the City centre before reaching their final destinations located along the outskirts of the City. Mini-bus taxis and buses are the only public transport modes servicing the corridor under study.

Mini-bus taxi counts show that there is a high number of taxis along the study corridor heading to the City centre. As a result, the City experiences congestion during peak hour periods. Taxi desire lines were located and intersection traffic counts were sought with the aim of investigating the impact of taxis. Two scenarios are therefore considered, namely;

Scenario1 – Existing conditions where taxis/buses with commuters enter the City centre – without feeder line-haul system

Scenario 2 – Proposed feeder-line-haul system where stations are located outside the City centre, with taxis feeding to these stations and medium sized buses take over the distribution role within the City.

The objectives of the project are listed below:

- Understand current travelling conditions - destinations, cost and travel time.
- Assess contribution of mini-bus taxis to delay and or level of service.
- Estimate the number of minibus taxis during peak hours.
- Estimate passenger demand.
- Consider reduction of mini-bus taxi fleet.

4.2 Scenario 1 - Existing conditions (without feeder-line-haul system)

4.2.1 O-D Surveys

The O-D survey focused on a typical one-way trip of commuters travelling from the Nsikazi area (Tekwane South and Lekazi) to Mbombela. The findings are presented below. The output from the *Kobotoolbox Software* is provided in *Appendix 5*.

Reason for travelling and mode of transport

The reasons to select from were, work, school and other. "Other" referred to reasons such as recreational, shopping, medical, etc. All thirty-three (33) participants responded to this question. The majority of commuters indicated work as their reason for travel (60%) followed by school (tertiary institutions) at 21%.

The target mode of transport were mini-bus taxi and bus. Mini-bus taxi users account for 61% of the two modes as shown in the figure below. This confirms the fact that taxis are the most popular mode of public transport in the study area. The results are presented graphically in the following figure.

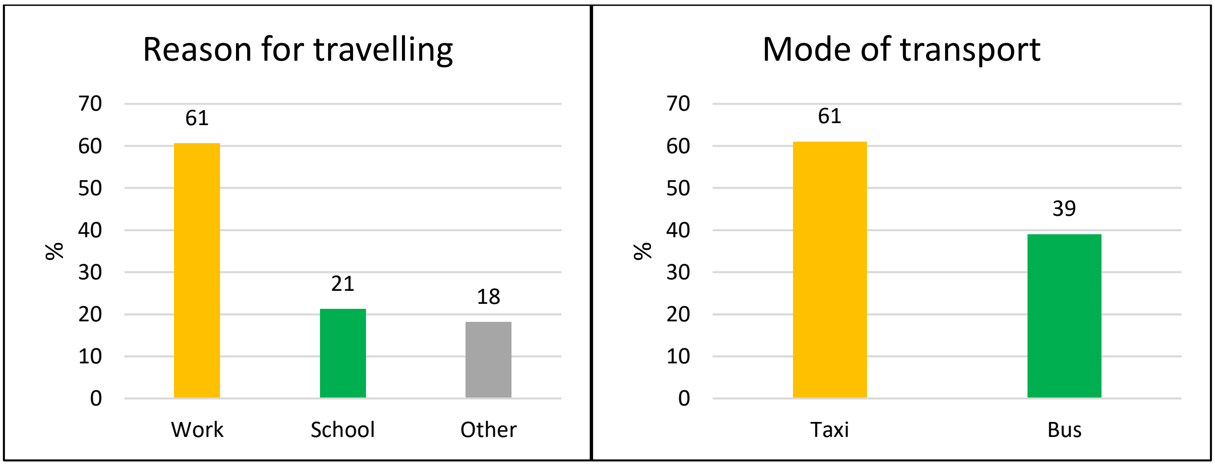


Figure 4.1: Graph showing reason for travelling and mode of transport

Percentage travelling to a destination

Thirty-two (32) of the 33 participants responded to this question. The results show that majority of commuters (66%) have destinations outside the City centre while about 34% end their trips in the CBD. It was also noted that areas such as Kamagugu and ILanga Mall recorded fewer number of people reaching these destinations. Kamagugu is a middle-class suburb with no significant economic base hence the relatively low attraction. The reason for low attraction to ILanga Mall can be attributed to the fact that this area attracts travellers seeking mainly recreational facilities. The university of Mpumalanga also revealed low attractions because it is still being developed. The Village and West Acres are high income residential areas with few areas of economic activity which agrees with the relatively low number of attractions. The results are presented in the following table.

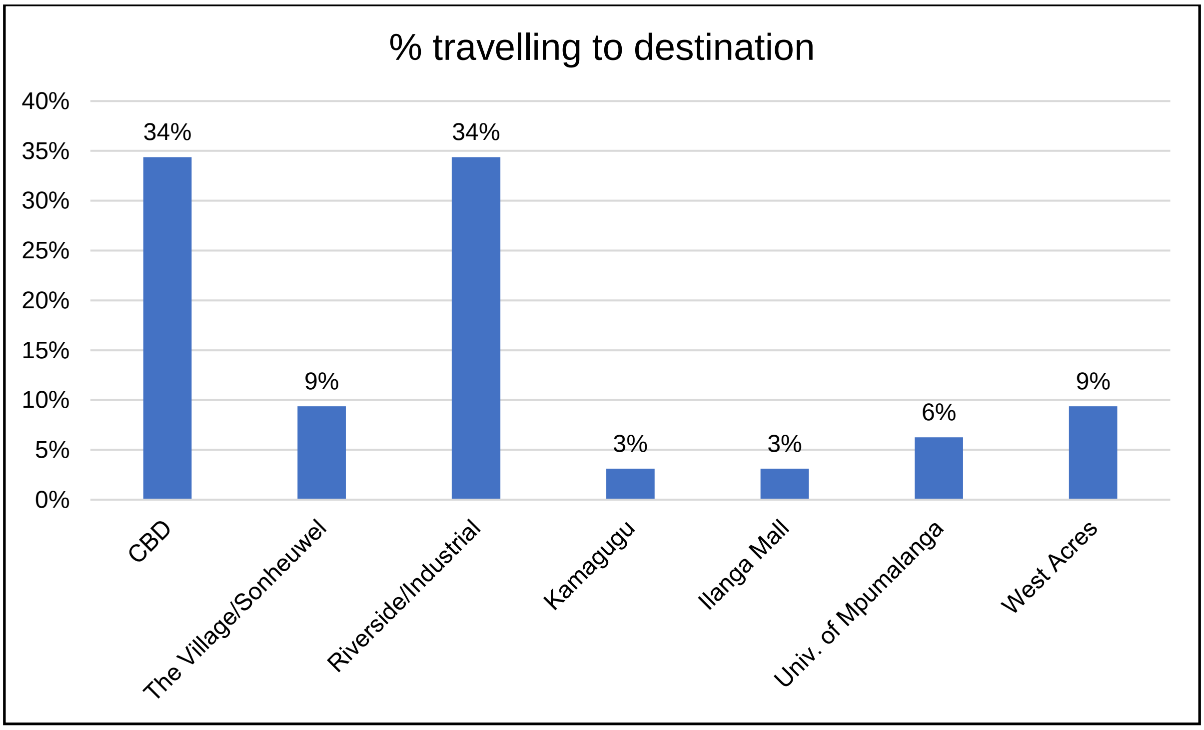


Figure 4.2: Percentage travel to destinations

Time and cost of travel

The figure below provides the cost (R) and time (min.) of travel to the destinations that were selected. The results include for both modes of travel. There is not a significant variation in the cost of travel, although there is some additional cost when travelling to iLanga Mall and Riverside Mall which are outside the CBD.

The average cost of travel is R21.35 for taxi travel and R22.7 for bus travel when (one direction). Assuming the normal 21-day work week, this amounts to R896.7 when travelling by taxi and R953.4 when travelling by bus per month. These costs are significantly higher than those reported by *Stats SA* in the 2014 household survey for the Mbombela area (R564 for taxi and R315 for bus). About 62.3% of households in South Africa fall within the poorest income bracket, below R86 000 per annum *(Ismail, Mkhwanazi, and Silberman, 2016*). This indicates that low-income passengers spend about 20% of their income on transport. The results also show that travelling by bus is more expensive compared to travelling by taxi which is contrary to what was reported by *Stats SA*.

Travel time for both modes range between 43 minutes to 70 minutes with an average of 55 minutes (one direction). This indicates that travellers spend between 1.4 hours and 2.3 hours per day traveling. Considering those travelling for work, these figures are in line with the findings by *Stats SA (60 min per direction)*.

It was noted that there are those who travel for around 70 minutes which is above the general “rule” or time budget in mobility of 1.5 hours per day for work travel. These are seen for travel to The Village, Kamagugu and Ilanga Mall which are located outside the City centre. The results are presented in the following figure.

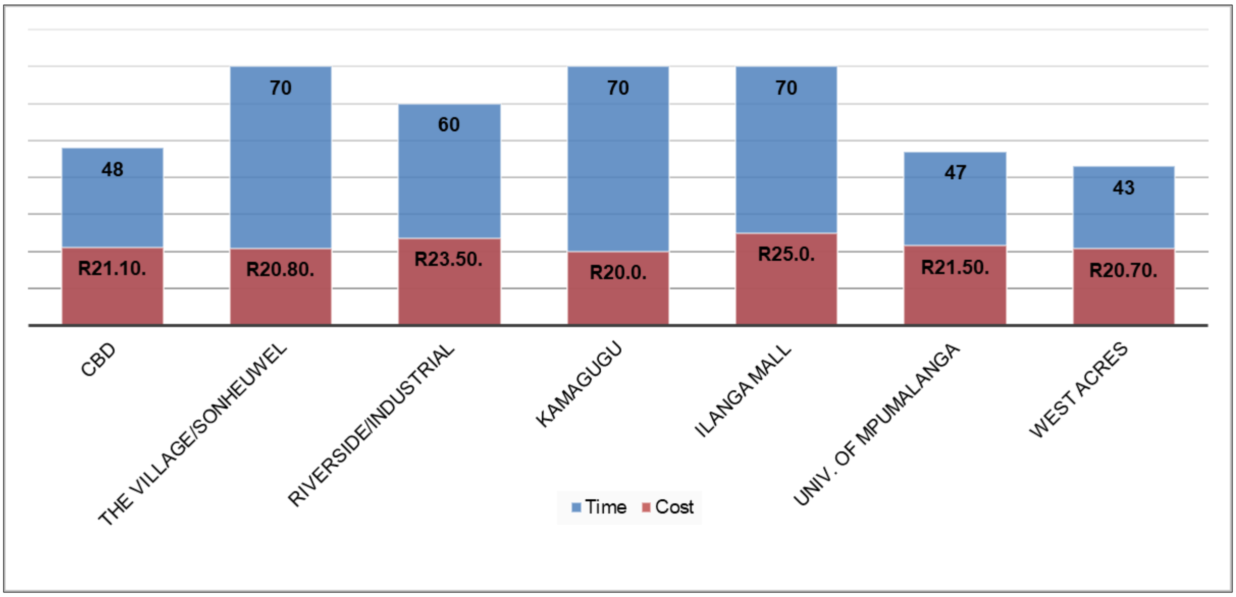


Figure 4.3: Time and cost of travel

<u>Changing vehicles along the route - Transfer</u>

Twenty six (26) participants responded to this question. It was found that 50% of the participants change vehicles along their journey. This indicates that a significant number of travellers have destinations outside the City centre.

<u>Conclusions from the O-D survey</u>

The findings of the O-D survey confirms the problem statement, highlighting that commuters make a stop in the City centre before reaching their final destination. Majority of the trips are for work purposes (61%) followed by school trips (18%). Mini-bus taxis carry the most number of people compared to buses, which is the case in every South African city.

The cost of travel is relatively similar for the selected destinations. The average monthly cost of travel by taxi was found to be R896.7 and R953.4 by bus. Travel time of the respondents generally agree with that reported by Stats SA, however, there are passengers who spend up to 2.3 hours per day travelling which is beyond the time budget of 1.5 hours per day.

Although a larger number of participants was initially targeted, the 33 participants that responded provide an idea of the existing travel patterns on public transport users along this corridor and the outcome confirms the problem statement of this project.

4.2.2 Mini-bus taxi counts

Taxi counts were carried out just outside of Tekwane South on Road D2296 from 06:00 to 09:00 AM for two weekdays. It was initially planned to conduct counts for at least three weekdays, however, the collapsing of a bridge near Tekwane South resulted in counts being carried out for two days.

One hundred and eighty seven (187) mini-bus taxis were recorded on Thursday, 28th January 2021 during the three hours while 208 taxis were recorded on Tuesday, 02nd February, 2021. Assuming similar volumes for both the morning and after peak periods, it can be concluded than there are more than 500 mini-bus taxis using this corridor during peak periods. The traffic study done on this route by *Rhandzu Projects* reported that 1200 mini-bus taxis use this route per day.

The peak hour flow rate was calculated and the results are shown in *Table 4.1* below. The peak hour was found to occur between 06:30 and 07:30 AM. Headways of 58 seconds and 49 seconds were recorded for the two days, respectively.

Table 4.1: Mini-bus taxi counts

Time		Taxis volumes	
From	**To**	**28-01-2021**	**02-02-2021**
06:00	06:15	19	14
06:15	06:30	13	20
06:30	06:45	23	26
06:45	07:00	20	18
07:00	07:15	21	23
07:15	07:30	20	21
07:30	07:45	17	20
07:45	08:00	14	20
08:00	08:15	19	15
08:15	08:30	8	11
08:30	09:45	5	8
08:45	09:00	8	12
Total		**187**	**208**
Peak Hour flow rate (vph)		**84**	**88**

4.2.3 Intersection traffic counts and analysis

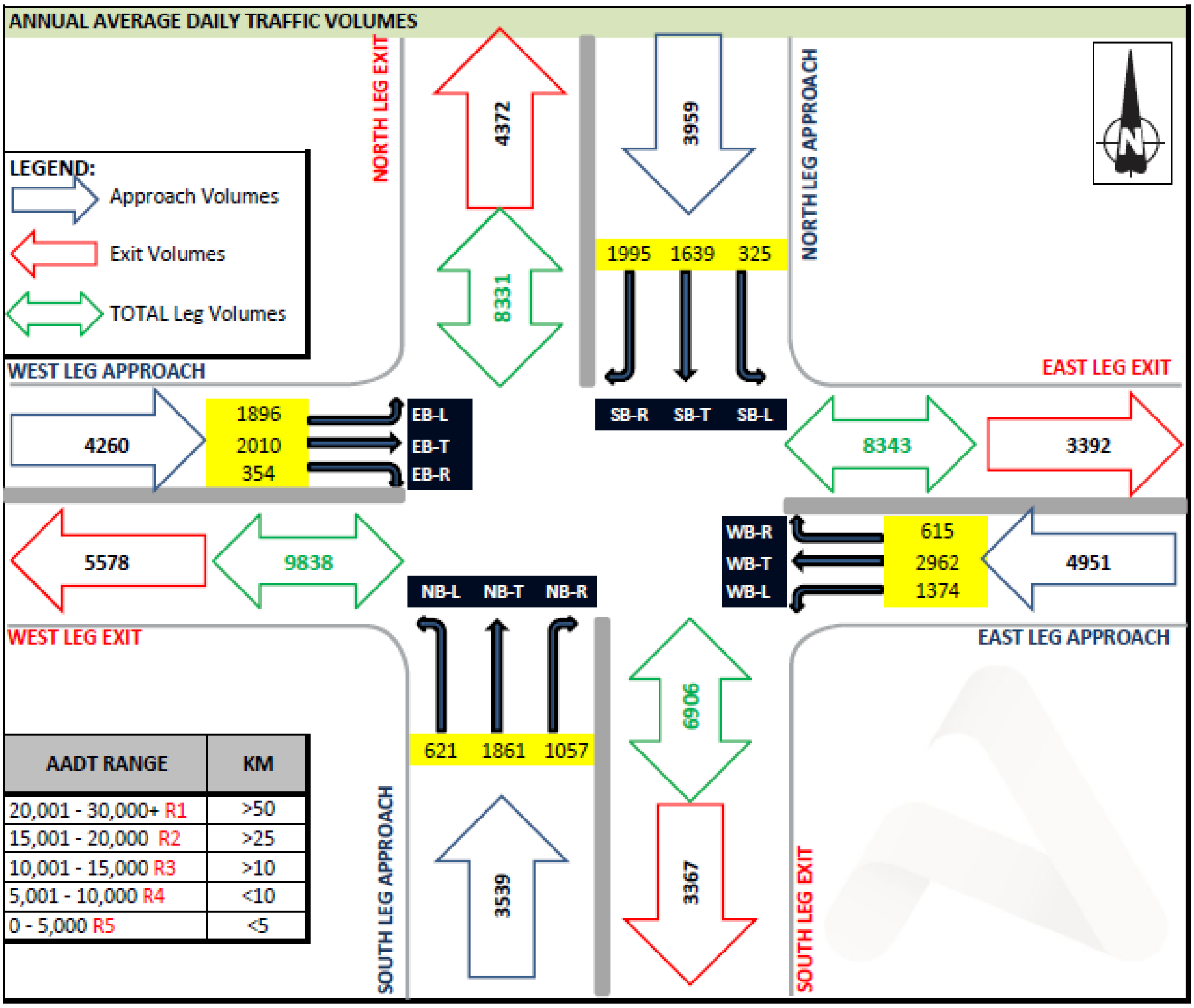
Traffic count information for several intersections within the City was provided by *Endecon Ubuntu,* who are responsible for the City's master plan. The data included peak hour volumes for morning and afternoon peak periods. It was required that a growth factor be applied as the counts were carried out prior to 2021. A growth factor of 4% per annum was selected based on other traffic studies carried out around the area.

Taxi desire lines were thereafter identified (from experience and site observations) and only the intersections along known taxi routes were investigated. To predict the existing conditions at these intersections a level of service (LOS) analysis was carried out as per the *Highway Capacity Manual (HCM) 6th Edition* using the *PTV Vistro Software*.

Nine intersections along the routes preferred by taxi drivers were analysed. It is known that these routes are congested during peak hour periods and taxis contribute significantly to this. The taxi routes and intersections are indicated in *Figure 4.4*.

The taxi counts as discussed in Section 4.2.2 above, together with traffic count information for an intersection along Road D2296/R538 were used to predict the percentage of taxis that enter the City. It was found that taxis account for around 13% of the traffic. The traffic information from this intersection is shown in *Figure 4.5*. The counts indicate that over 1200 mini-bus taxis use Road D2296 daily.

Figure 4.4: Taxi route network and affected intersections



MODE	North Leg-Appr	North Leg-Exit	South Leg-Appr	South Leg - Exit	West Leg - Appr	West Leg - Exit	East Leg - Appr	East Leg - Exit
LV	2999	3159	2648	2664	3246	4278	4024	2816
MINIBUS	463	619	286	315	581	675	496	217
BUS	116	220	249	9	41	181	58	54
TRUCK S	162	131	65	122	200	193	115	96
TRUCK M	134	120	145	161	137	201	211	145
TRUCK L	84	117	136	94	52	48	43	56
AG VEH	1	6	10	2	3	2	4	8
TOTAL	3959	4372	3539	3367	4260	5578	4951	3392
LEG TOTAL	8331		6906		9838		8343	

Figure 4.5: Traffic count data for D2296/R538 (Rhandzo Projects, 2020)

It is expected that the majority of the above number of taxis enter the City's centre through the intersection of D2296/Friedenheim Rd. This intersection was therefore the first point of analysis. The estimated total peak hour flow rate into the CBD through this intersection is 442 veh/hr (AM peak) with 58 veh/hr (13%) being taxi demand, and 1070 veh/hr (PM peak) with 139 veh/hr being taxi demand. These values are comparable to the peak hour flow rate (88 taxis/hr) when assuming pre-covid-19 conditions. The intersection layout is shown in *Figure 4.6*. A LOS analysis was carried out for this intersection to assess the current operating conditions.

According to the *HCM 6th Edition*, control delay is used to characterize LOS for signalised intersections or an approach movement. Delay is the increase in travel time due to traffic signal control. The volume to capacity ratio (v/c) together with delay are used to characterize the LOS for a lane group. v/c ratio quantifies the degree to which a phase's capacity is utilised by a lane group used. *Table 4.2* provides the level of service criteria for signalised and stop controlled intersections.

Table 4.2: LOS criteria vehicle mode

LEVEL OF SERVICE (LOS)	SIGNALISED	STOP CONTROLLED	VOLUME/CAPACITY RATIO
	CONTROL DELAY (s/veh)		
A	≤10	0-10	≤1.0
B	>10-20	>10-15	≤1.0
C	>20-35	>15-25	≤1.0
D	>35-55	>25-35	≤1.0
E	>55-80	>35-50	≤1.0
F	>80	>50	>1

For the signalised traffic control, a fully actuated controller type was adopted based on the methodology of the *HCM*. Signal timings for each of the intersections were not considered in isolation, therefore, typical values were used. A high level analysis approach was found to be sufficient for the purpose for this study.

It was found that the overall intersection operates at LOS F during both the AM and PM peak periods. The exclusive left movement into the CBD operates at LOS D during the AM peak and at LOS F during PM peak. This movement is known to be used primarily by mini-bus taxis. The impact of the taxis towards the operation of the intersections is analysed in the following sub-section where the taxis are removed from the flow. The intersection layout is shown in *Figure 4.6* and the summary of the capacity analysis is provided in *Table 4.3*.

The remainder of the intersections were also analysed to assess the existing conditions in a similar manner. The results are presented in *Tables 4.4* and *4.5*. The majority of the intersections currently operate at unacceptable LOS for the PM peak. This confirms the current observed congestion at intersections along taxi desire lines. The detailed analysis results are provided in *Appendix 6*.

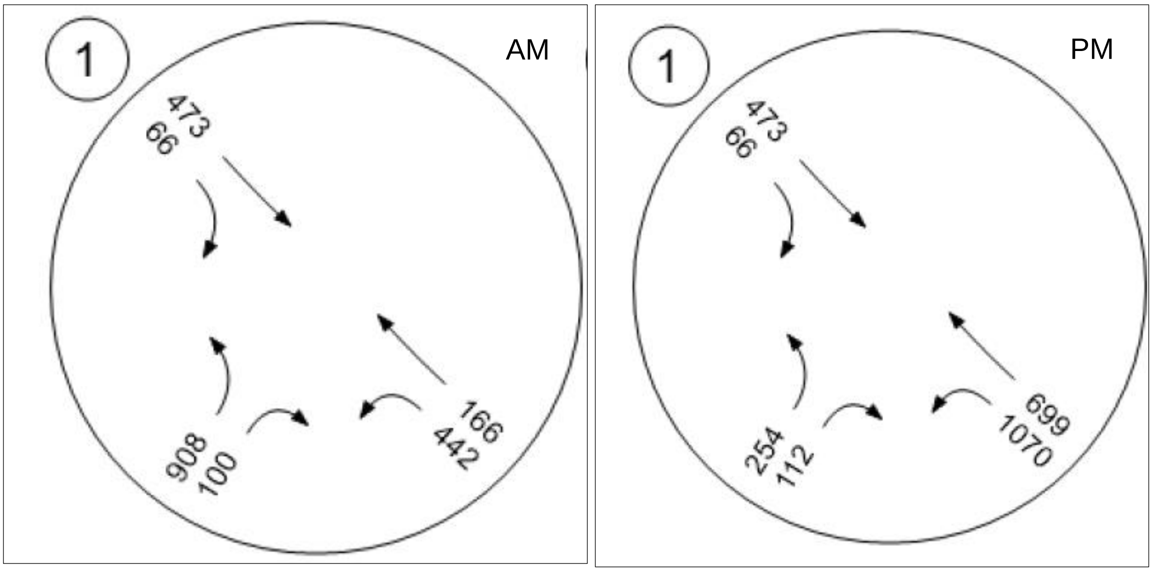
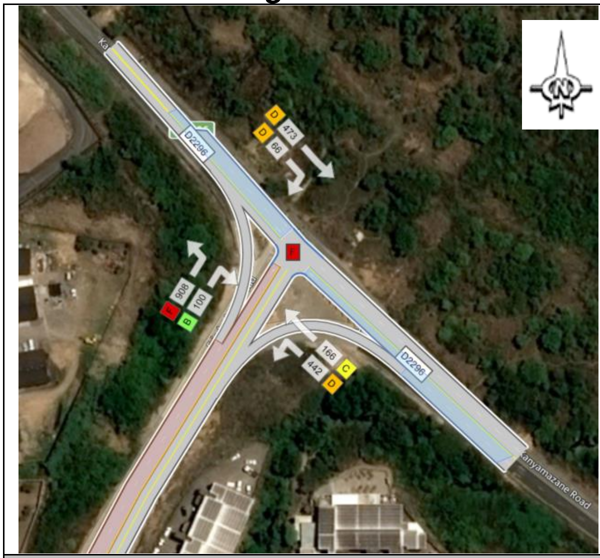


Figure 4.6: D2296/Friedenheim Rd layout and demand volumes – AM & PM peak

Table 4.3: Existing traffic demand and capacity – D2296/Friedenheim Rd



AM PEAK					PM PEAK				
LEG	v/c	Delay (s/veh)	Queue (m)	LOS	LEG	v/c	Delay (s/veh)	Queue (m)	LOS
NB - Left	1.70	351.03	733.20	F	NB - Left	0.82	32.08	61.20	C
NB - Right	0.17	18.99	19.27	B	NB - Right	0.33	24.40	22.66	C
SB-Thru	0.83	38.67	72.67	D	SB-Thru	0.8	31.21	60.01	C
SB - Right	0.84	33.32	77.40	D	SB - Right	0.8	30.93	63.82	C
WB - Left	0.93	47.64	127.29	D	WB - Left	1.66	324.60	800.63	F
WB - Right	0.3	22.31	34.95	C	WB - Right	0.92	34.08	144.01	C

Table 4.4: Existing intersection analysis summary – AM peak

ID	Intersection Name	Control Type	Method	Worst Mvmt	V/C	Delay (s/veh)	LOS
1	D2296/ Friedenheim Rd	Signalized	HCM 6th Edition	NB Left	1,054	170,0	F
3	Kragbron Rd/ Timerhout St	All-way stop	HCM 6th Edition	SB Thru	0,815	24,2	C
6	Bester St/ Corrier St	Signalized	HCM 6th Edition	SB Left	0,586	54,3	D
7	Bester St/ Henshall St.	Signalized	HCM 6th Edition	NB Right	0,616	49,5	D
8	Samora Machel Dr/ Henshall St.	Signalized	HCM 6th Edition	EB Left	0,985	81,2	F
9	Bell St./Henshall St.	Signalized	HCM 6th Edition	SB Right	1,458	253,2	F
10	Andrew St/ Henshall St	All-way stop	HCM 6th Edition	EB Right	0,400	10,5	B
11	Old Pretoria Rd/ Madiba Dr	Signalized	HCM 6th Edition	SB Right	3,834	419,5	F
12	Andrew St/ Paul Kruger St	Two-way stop	HCM 6th Edition	NB Right	0,245	84,3	F

Table 4.5: Existing intersection analysis summary – PM peak

ID	Intersection Name	Control Type	Method	Worst Mvmt	V/C	Delay (s/veh)	LOS
1	D2296/ Friedenheim Rd	Signalized	HCM 6th Edition	WB Left	1,036	149,1	F
3	Kragbron Rd/ Timerhout St	All-way stop	HCM 6th Edition	SB Right	1,318	87,8	F
6	Bester St/ Corrier St	Signalized	HCM 6th Edition	NB Right	0,589	59,4	E
7	Bester St/ Henshall St.	Signalized	HCM 6th Edition	NB Right	0,912	63,6	E
8	Samora Machel Dr/ Henshall St.	Signalized	HCM 6th Edition	EB Thru	1,110	123,3	F
9	Bell St./Henshall St.	Signalized	HCM 6th Edition	SB Right	1,472	151,0	F
10	Andrew St/ Henshall St	All-way stop	HCM 6th Edition	EB Right	0,614	14,4	B
11	Old Pretoria Rd/ Madiba Dr	Signalized	HCM 6th Edition	SB Right	3,182	402,3	F
12	Andrew St/ Paul Kruger St	Two-way stop	HCM 6th Edition	NB Right	0,507	338,3	F

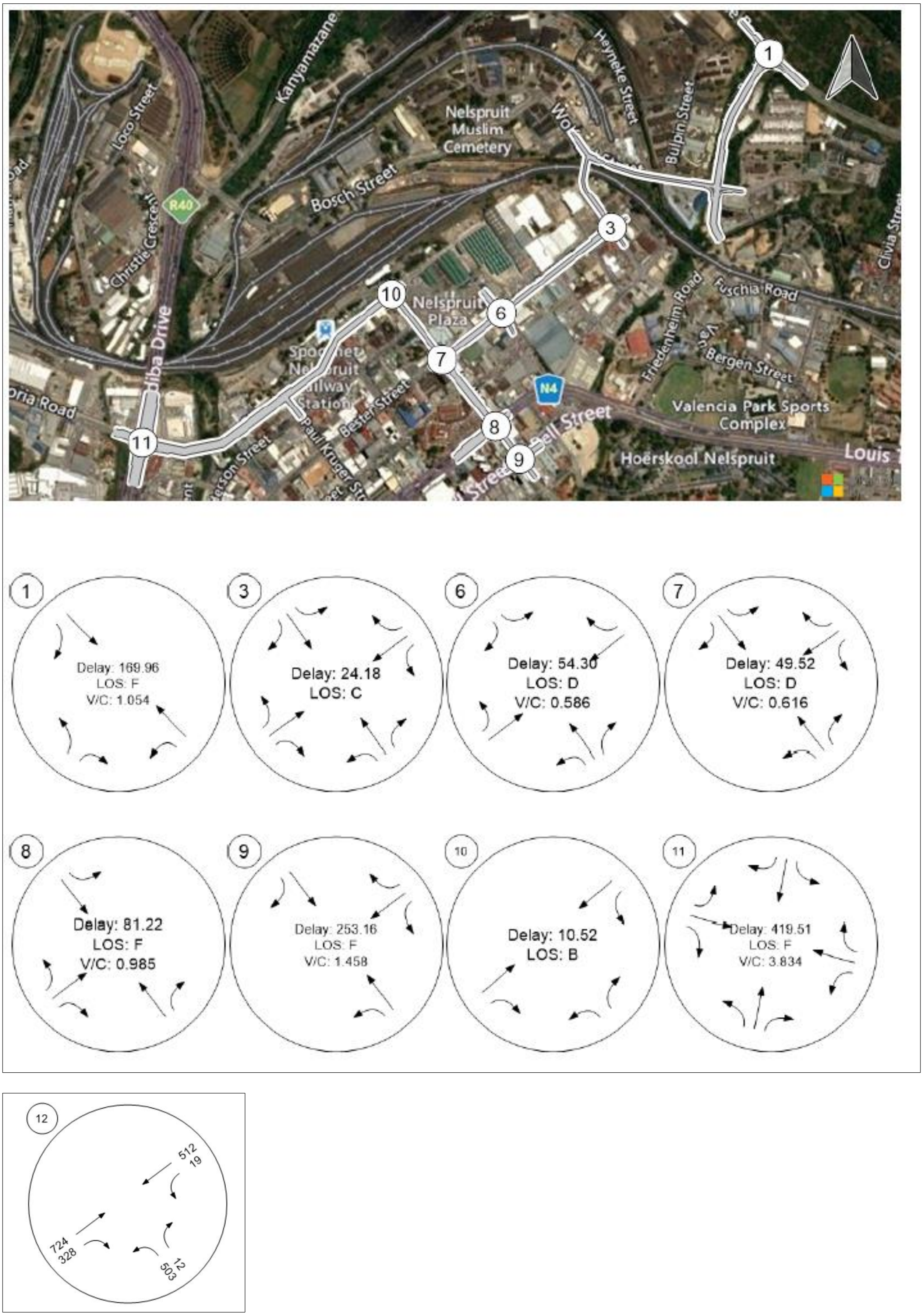


Figure 4.7: Intersection LOS analysis – AM peak

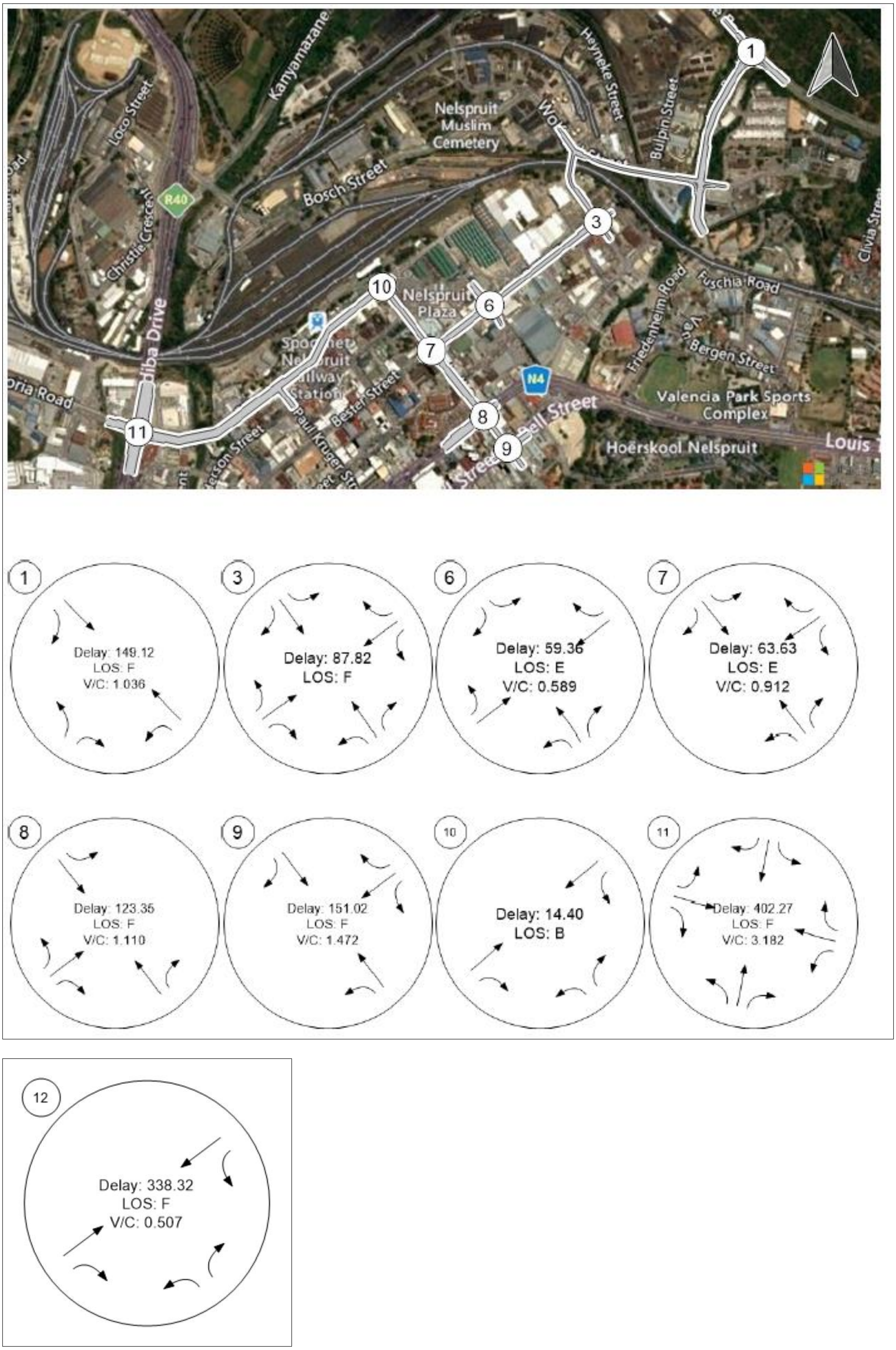


Figure 4.8: Intersection LOS analysis – PM peak

4.3 Scenario 2 – Feeder line-haul system implemented

4.3.1 Removing taxis from the City and replace with buses

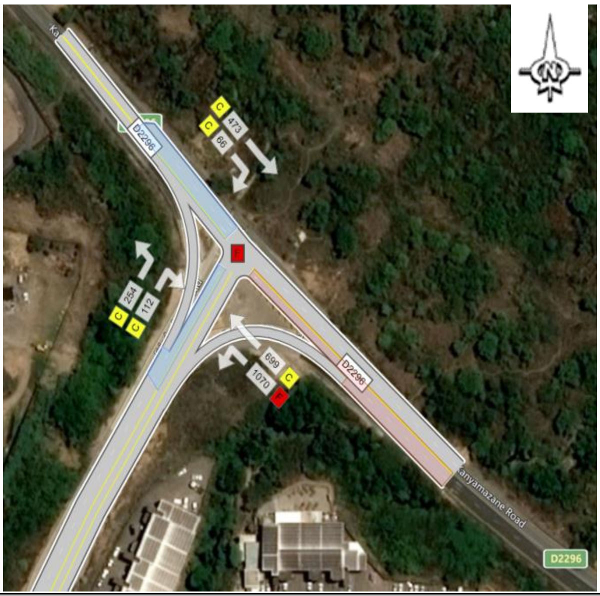
The proposed feeder-line-haul system assumes that taxis do not enter the City centre but rather feed to stations located at the outskirts and medium sized buses take over the distribution role within the City.

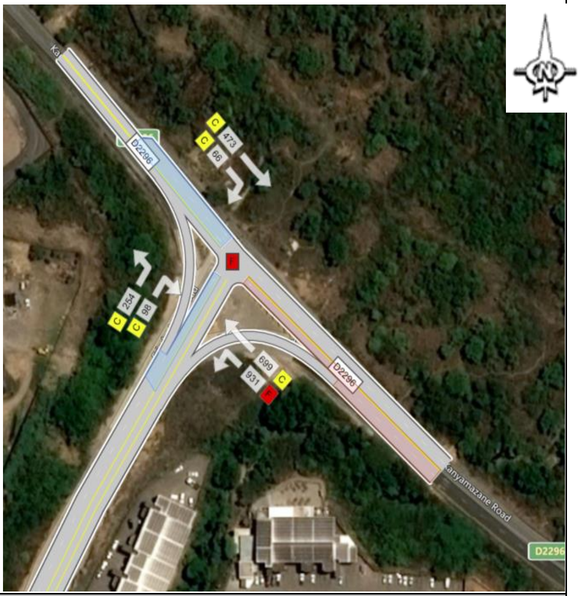
The intersections under consideration were analysed considering a scenario where taxis flock into the CBD. The objective was to assess if removing taxis will improve the level of service of the intersection as whole or the lanes occupied by taxis during the peak period. The analysis was carried out using the *HCM* methodology and the results for each intersections are presented in the following tables. It was noted that the PM peak is the most affected period and the results of this period are presented. The AM peak results are included in *Appendix 6*. The movements/lanes occupied by taxis are highlighted in the tables.

D2296/Freiddenheim Rd – Signalised: PM Peak

It appears from the analysis of this intersection that removing taxis from the traffic demand does not improve the level of service of the movement into the CBD. However, there is some gain with respect to delay. This indicates that to improve operations at this intersection, its capacity needs to be increased.

Table 4.6: D2296/Freiddenheim Rd – PM Peak



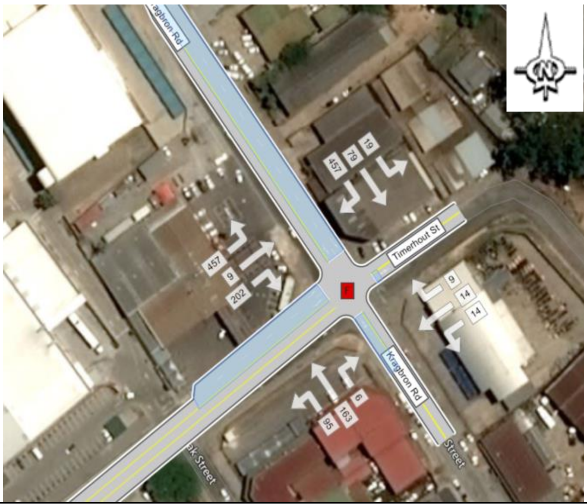


Scenario 1 – With Taxis					Scenario 2 – Without Taxis				
Movement	**v/c**	**Delay (s/veh)**	**Queue (m)**	**LOS**	**Moveme nt**	**v/c**	**Delay (s/veh)**	**Queue (m)**	**LOS**
NB - left	0.82	32.08	61.20	C	NB - left	0.83	32.16	61.25	C
NB - right	0.33	24.40	22.66	C	NB - right	0.28	24.11	19.57	C
SB-thru	0.8	31.21	60.01	C	SB-thru	0.8	31.19	59.97	C
SB - right	0.8	30.93	63.82	C	SB - right	0.8	30.91	63.77	C
WB - left	**1.66**	**324.60**	**800.63**	F	**WB - left**	**1.45**	**228.92**	**570.19**	F
WB - right	0.92	34.08	144.01	C	WB - right	0.92	33.96	143.69	C

<u>Kragbron Rd/Timerhout St – All way-stop: PM Peak</u>

The results from this intersection show that there is improvement in LOS on the leg occupied by taxis from LOS E to LOS D when taxis are removed from the demand flow rate.

Table 4.7: Kragbron Rd/Timerhout St – PM Peak

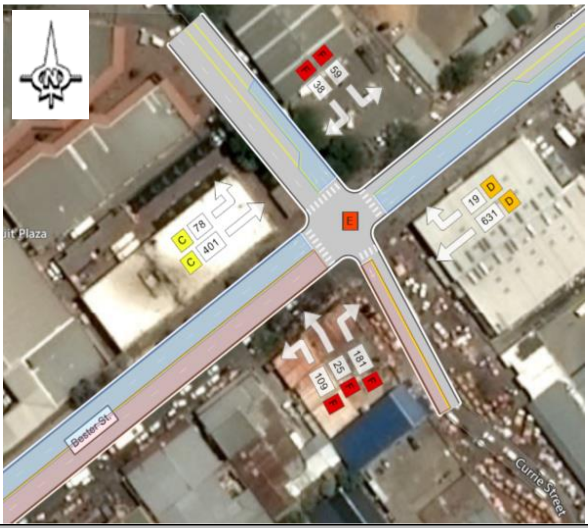


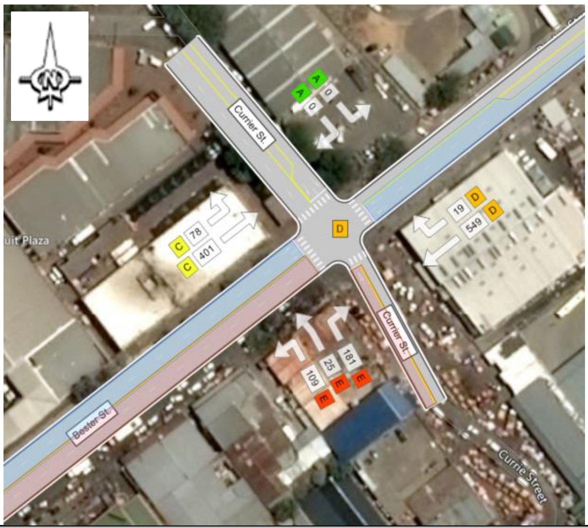
Scenario 1 – With Taxis					Scenario 2 – Without Taxis				
LEG	**v/c**	**Delay (s/veh)**	**Queue (m)**	**LOS**	**LEG**	**v/c**	**Delay (s/veh)**	**Queue (m)**	**LOS**
NB	-	19.47	25.16	C	NB	-	18.68	24.13	C
SB	-	175.74	2.3.44	F	SB	-	108.01	143.51	F
EB	**-**	**41.69**	**41.69**	**E**	**EB**	**-**	**27.53**	**17.40**	**D**
WB	-	12.56	2.23	B	WB	-	12.35	2.18	B

Bester St/Corrier St – Signalised: PM peak

The SB leg of this intersection is the entrance to the taxi rank and only taxis primarily use this leg. It can be seen that removal of the taxis has a significant contribution the LOS of the overall intersection.

Table 4.8: Bester St/Corrier St– PM Peak



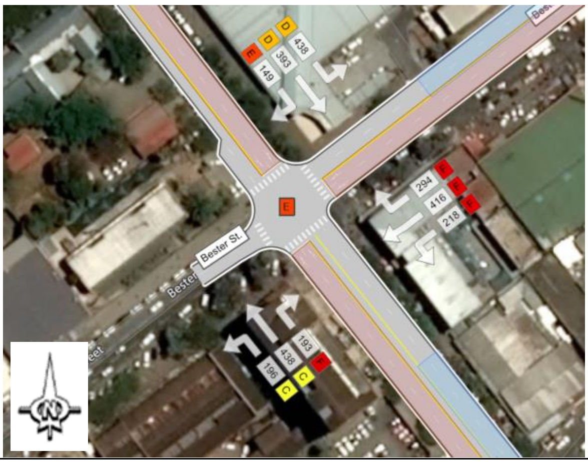


Scenario 1 – With Taxis					Scenario 2 – Without Taxis				
Lane group	**v/c**	**Delay (s/veh)**	**Queue (m)**	**LOS**	**Lane group**	**v/c**	**Delay (s/veh)**	**Queue (m)**	**LOS**
NB	0.95	134.05	226.58	F	NB	0.58	69.94	171.08	E
SB-left	**0.2**	**83.28**	**42.26**	**F**	**SB-left**	**-**	**0.00**	**0.00**	**A**
SB-right	**0.12**	**80.99**	**26.51**	**F**	**SB-right**	**-**	**0.00**	**0.00**	**A**
EB-Left	0.09	25.39	29.08	C	EB-Left	0.10	26.83	29.99	C
EB-thru	0.41	32.16	147.84	C	EB-thru,	0.42	34.00	151.79	C
WB-thru	**0.64**	**40.43**	**257.70**	**D**	**WB-thru**	**0.57**	**39.15**	**220.43**	**D**
WB-right	0.04	42.06	9.33	D	WB-right	0.05	44.42	9.61	D

<u>Bester St/ Henshall St – Signalised: PM Peak.</u>

Analysis of this intersection also shows improvement in LOS of the lane groups occupied by taxis. The overall intersection LOS however remains at level of service E.

Table 4.9: Bester St/Henshall St– PM Peak with scenario 2



Scenario 1 – With Taxis					Scenario 2 – Without Taxis				
Lane group	**v/c**	**Delay (s/veh)**	**Queue (m)**	**LOS**	**Lane group**	**v/c**	**Delay (s/veh)**	**Queue (m)**	**LOS**
NB-left, thru	0.66	31.9	235.7	C	NB-left, thru	0.65	32.85	224.11	C
NB-thru, right	0.85	116.06	146.37	F	NB-thru, right	0.74	90.70	128.23	F
SB-left, thru	**0.74**	**36.42**	**270.31**	**D**	**SB-left, thru**	**0.69**	**34.80**	**231.84**	**C**
SB-thru, right	0.72	73.04	180.69	E	SB-thru, right	0.67	70.740	152.08	E
WB-left, thru	**0.86**	**92.15**	**260.62**	**F**	**WB-left, thru**	**0.74**	**74.19**	**213.07**	**E**
WB-thru, right	**0.86**	**89.99**	**294.72**	**F**	**WB-thru, right**	**0.74**	**72.92**	**239.39**	**E**

<u>Samora Machel Dr/Henshall St – Signalised: PM peak</u>

For this intersection, it was found that removal of taxis results in improvement in the LOS of other lane groups other than those occupied by taxis. It was further noted that the LOS on lanes occupied by taxis reduced as a result thereof. To understand this result, one would have to do a more detailed analysis to assess the impact.

Table 4.10: Samora Machel Dr/Henshall St– PM Peak with scenario 2

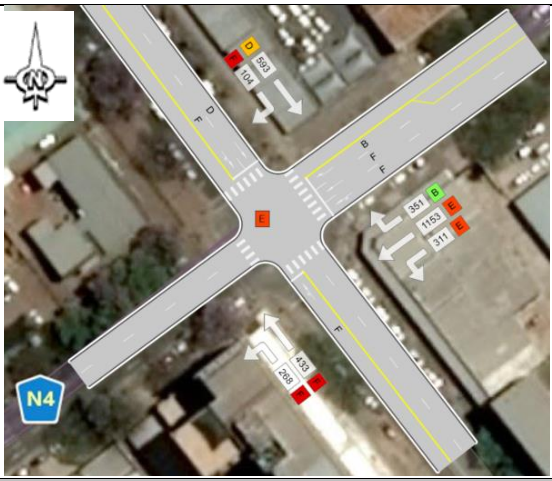
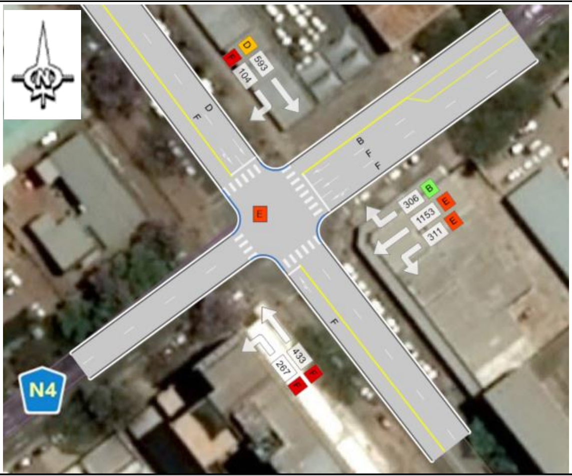
Scenario 1 – With Taxis					Scenario 2 – Without Taxis				
Lane group	**v/c**	**Delay (s/veh)**	**Queue (m)**	**LOS**	**Lane group**	**v/c**	**Delay (s/veh)**	**Queue (m)**	**LOS**
NB-thru, right	**1.08**	**106.38**	**583.50**	**F**	**NB-thru, right**	**1.10**	**122.22**	**559.72**	**F**
SB-left	**0.54**	**19.79**	**163.74**	**B**	**SB-left**	**0.49**	**22.60**	**153.08**	**C**
SB-thru	0.35	15.43	109.60	B	SB-thru	0.37	19.38	122.61	B
EB-left,	0.75	92.91	190.43	F	EB-left,	0.66	79.74	178.06	E
EB-thru,	1.25	208.56	434.01	F	EB-thru,	1.10	139.79	378.48	F

EB-right	0.67	85.82	181.33	F	EB-right	0.59	75.13	170.80	E

Bell St/Henshall St. – Signalised; PM peak

It was found that the removal if taxis from this intersection does not impact the existing LOS. The intersection remains at LOS E. There is however, reduction in delay (10 seconds) along the WB-right movement occupied by taxis.

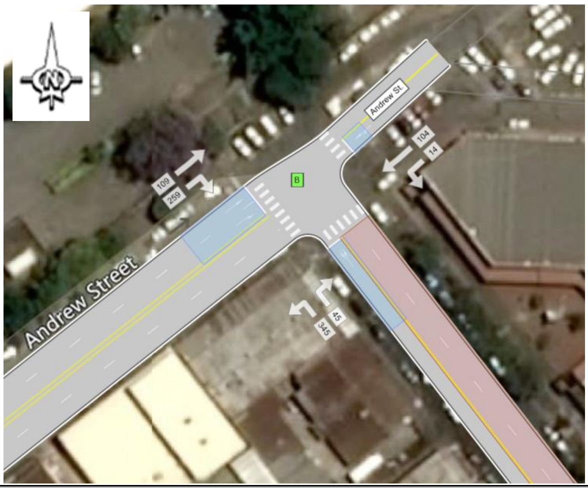
Table 4.11: Bell St/Henshall St– PM Peak with scenario 2

									
Scenario 1 – With Taxis					**Scenario 2 – Without Taxis**				
Lane group	**v/c**	**Delay (s/veh)**	**Queue (m)**	**LOS**	**Lane group**	**v/c**	**Delay (s/veh)**	**Queue (m)**	**LOS**
NB-left, thru	1.09	82.45	231.62	F	NB-left, thru	1.09	81.87	230.39	F
SB-thru	0.95	44.20	142.78	D	SB-thru	0.95	44.20	142.78	D
SB-thru, right	1.06	140.77	64.35	F	SB-thru, right	1.06	140.77	64.35	F
WB-left, thru	1.07	74.21	225.42	F	WB-left, thru	1.07	73.07	222.75	F
WB-thru,	1.00	52.47	186.74	E	WB-thru,	1.01	53.32	188.88	E
WB-right	**0.50**	**15.86**	**55.86**	**B**	**WB-right**	**0.44**	**14.82**	**45.91**	**B**

Andrew St/Henshall St. – 3-way stop: PM peak

This intersection generally operates at acceptable LOS with or without taxis. Removal of the taxis further improves the LOS on two of the legs. It should be noted however that the queue length from the adjacent signalised intersection (Bester St/Henshall St) should affect this intersection. This is not shown here since the 3-way stop was analysed in isolation.

Table 4.12: Andrew St/Henshall St– PM Peak with scenario 2



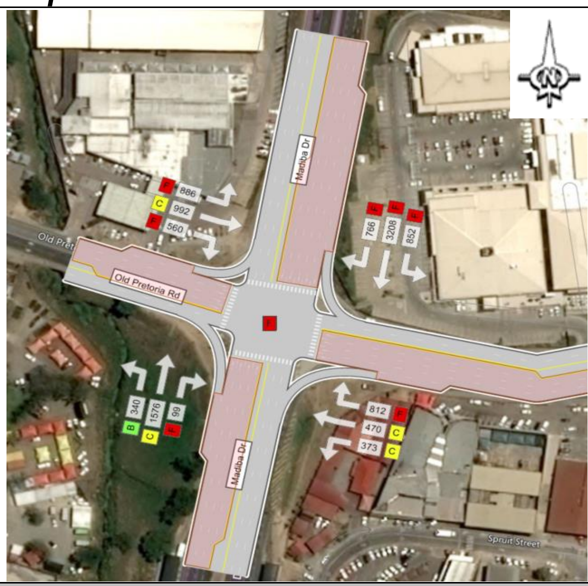
Scenario 1 – With Taxis					Scenario 2 – Without Taxis				
Leg	**v/c**	**Delay (s/veh)**	**Queue (m)**	**LOS**	**Leg**	**v/c**	**Delay (s/veh)**	**Queue (m)**	**LOS**
NB	**-**	**15.44**	**32.41**	**C**	**NB**	**-**	**12.55**	**22.48**	**B**
EB	**-**	**14.53**	**23.96**	**B**	**EB**	**-**	**12.57**	**17.46**	**B**
WB	**-**	**10.51**	**6.36**	**B**	**WB**	**-**	**9.77**	**5.02**	**A**

<u>Old Pretoria Rd/Madiba Dr – Signalised: PM peak</u>

This intersection is one of the most affected since it accommodates a very high number of vehicles. Removal of taxis from the traffic stream resulted in no improvement to the LOS.

Table 4.13: Old Pretoria Rd/Madiba Dr – PM peak– PM Peak with scenario 2

Scenario 1 – With Taxis



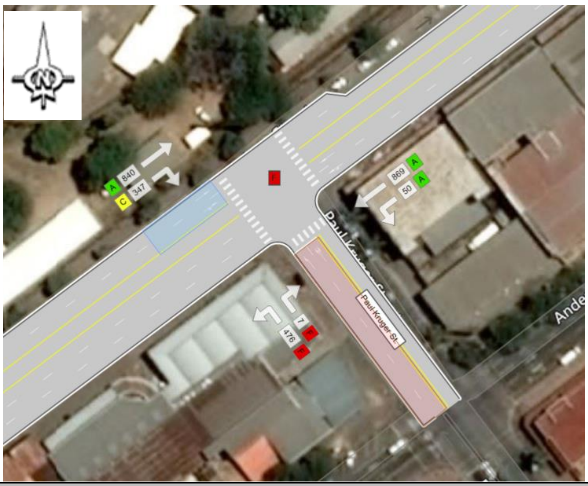
Scenario 2 – Without Taxis

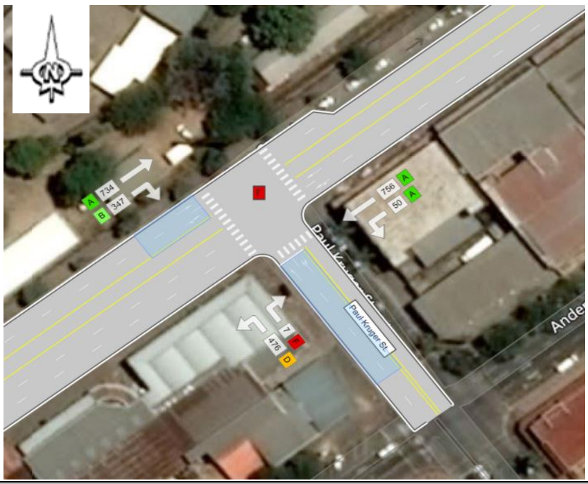
Lane group	v/c	Delay (s/veh)	Queue (m)	LOS	Lane group	v/c	Delay (s/veh)	Queue (m)	LOS
NB-left	0.52	19.23	68.55	B	NB-left	0.50	19.17	72.17	B
NB-thru	0.76	21.74	106.43	C	NB-thru	0.72	21.61	112.65	C
NB-right	1.30	245.61	85.05	F	NB-right	1.44	312.02	96.13	F
SB-left	**1.51**	**259.87**	**683.82**	**F**	**SB-left**	**1.25**	**150.64**	**451.49**	**F**
SB-thru	1.54	269.87	754.87	F	SB-thru	1.47	240.38	726.49	F
SB-right	4.93	1821.94	573.49	F	SB-right	4.60	1679.3	571.68	F
EB-left	1.51	261.13	621.63	F	EB-left	1.55	285.94	667.77	F
EB-thru	0.75	25.23	108.13	C	EB-thru	0.78	29.38	123.50	C
EB-right	1.04	82.53	119.22	F	EB-right	1.10	106.27	140.18	F
WB-left	0.63	24.81	84.16	C	WB-left	0.65	28.66	95.34	C
WB-thru	0.36	17.81	45.87	B	WB-thru	0.37	20.67	53.77	C
WB-right	**4.69**	**1712.10**	**676.17**	**F**	**WB-right**	**4.62**	**1687.7**	**593.91**	**F**

Andrew St/Paul Kruger St – 1-way stop: PM peak

The NB leg is the most affected on the intersection. Removal of taxis does improve the LOS for the NB-left movement.

Table 4.14: Andrew St/Paul Kruger St – PM peak– PM Peak with scenario 2





Scenario 1 – With Taxis					Scenario 2 – Without Taxis				
Lane group	v/c	Delay (s/veh)	Queue (m)	LOS	Lane group	v/c	Delay (s/veh)	Queue (m)	LOS
NB-left	0.95	50.58	45.47	F	NB-left	0.87	25.04	29.34	D
NB-left, right	0.51	338.32	71.28	F	NB-left, right	0.30	182.18	41.71	F
EB-thru	**-**	**-**	**11.39**	**A**	**EB-thru**	**-**	**-**	**9.49**	**A**
EB-thru, right	**0.52**	**15.38**	**22.78**	**C**	**EB-thru, right**	**0.74**	**13.51**	**18.98**	**B**
WB-thru, left	**-**	**-**	**0.00**	**A**	**WB-thru, left**	**-**	**-**	**-**	**A**
WB-thru	**-**	**-**	**0.00**	**A**	**WB-thru**	**-**	**-**	**-**	**A**

4.3.2 Passenger demand estimation

The main objective of this study is to investigate the feasibility of implementing a feeder-line-haul system in the City of Mbombela, where mini-bus taxis will feed into stations placed along the outskirts of the City and medium sized buses taking over the distribution role. It is therefore critical for such a system to support a passenger demand that allows for its optimal function.

There is currently a formal bus system operating in and around Mbombela transporting around 160 000 passengers a day as reported by *Buscor (Pty) Ltd*. All bus trips terminate in the CBD and passengers with destinations outside the City centre are forced to transfer. The informal mini-bus service operates in a similar manner. This study focuses on the Mbombela-Kanyamazane corridor and the passenger demand along this line is estimated.

It was recorded that around 200 taxis transport passengers from Kanyamane to Mbombela during the AM peak period. From the counts, a peak flow rate of 88 taxis/hr was calculated. During peak hours, taxis carry the maximum allowed number of passengers (15 pass/taxi) and this was also observed during the counting exercise. The station was located at the exit point from the townships (near Tekwane South). The estimated passenger demand (P_{max}) generated by taxis is therefore 1320 pass/hr. Additional to this demand would be the demand generated by buses which was not estimated under this study.

The table below is an extract from the *Bus Rapid Transit Planning Guide, June 2007, developed by W Hook, Viva Cities.* Hook defines the above assessment as the rapid demand assessment method which is a cost effective way on which cities can begin the process of decision making regarding BRT systems. The rapid assessment can thereafter be developed into a formal transportation model which is beyond the scope of this project.

From the table below it can be seen that passenger demand for the City of Mbombela is within reach for a BRT solution to be initiated. The demand estimated for the Mbombela-Kanyamazane corridor with additional demand from the local bus system and demand from the north-south corridors may be well within the 2000 to 8000 passengers per hour demand bracket. The City currently has and *Integrated Public Transport Network Programme (IPTN)* which aims to integrate the existing bus and mini-bus systems to respond effectively to the current demand.

Table 4.15: Typical solutions for different demand levels (W Hook, 2007)

Transit passengers per hour per direction	Type of BRT solution
Less than 2,000	Simple bus priority, normally without physical segregation, possible part-time bus lane
2,000 to 8,000	Segregated median busway used by direct services reducing the need to transfer
8,000 to 15,000	Segregated median busway used by trunk services requiring transfers but benefiting from fast boarding and operating speeds. Transit priority at intersections.
15,000 to 45,000	Segregated median busway, with overtaking at stops; possible use of express and stopping services. Use of grade separation at some intersections and some form of signal priority at others.
Over 45,000	This level of demand is very rare on existing bus systems. It is possible, however, to design a BRT system that would serve up to even 50,000 passengers per hour per direction. This can be achieved with full segregation, double busway, a high proportion of express services and multiple stops. This capacity could also be handled by spreading the load through two or more close corridors.

4.3.3 Estimation of reduction in mini-bus taxi fleet

The Mbombela-Kanyazane Corridor covers a distance of 19 km from Kanyamazane to the intersection with Frieddeinhem Rd before entering the CBD. This is a possible position where a station can be placed. The allowable posted speed is 80 km/hr. Therefore, the travel time for a mini-bus taxi under normal conditions would be around 15 minutes. The following table provides a summary of the calculations.

Table 4.16: Results of mini-bus taxi fleet reduction calculations

Demand (P_{max})	1320 pass/hr
Line distance (L	19 km
Operating time (T_0)	15 min
Terminal lime (T_t)	3 min (assumed off loading/loading time)
Load factor (α_{max})	0,9 (peak direction)
Vehicle capacity (C_v)	15 passengers
Adjusted current frequency (f)	97 taxis/hr
The total cycle time (T)	36 min
Theoretical headway is (h)	0,61 min
Therefore, fleet size (N)	59 taxis/hr <97 taxis/hr

To estimate the resulting fleet, the following parameters are applicable:

Demand (P_{max}) = *1320 pass/hr*

Line distance (L) = *19 km*

Operating time (T_0) = *15 min*

Terminal lime (Tt) = *3 min (assumed off loading/loading time)*

Load factor (α_{max}) = *0,9 (peak direction)*

Vehicle capacity (C_v) = *15 passengers*

Adjusted current frequency (f) $= P_{max}/\alpha_{max} x C_v$

$=1320/0,9x15$

= *97 taxis/hr*

The total cycle time (T) $= 2x(15+3)$

= *36 min*

Theoretical headway is (h) $= 60x\ \alpha_{max} x C_v / P_{max}$

=60x0,9x15/1320

= 0,61 min

Therefore, fleet size (N) = T/h

=36min/0,61 = 59 taxis <97 taxis

It can therefore be concluded that using the mini-bus taxis as feeders to stations would result in a reduction in fleet and subsequently reduce operational costs. It should be noted though that tactors such as the time it takes to load passengers and other delays along the corridor may affect this result. However, it is well known that taxi drivers will always make means to avoid delays.

4.3.4 Cost and time savings

The O-D survey provided an indication of the financial costs to passengers along this corridor. To investigate the financial cost saving that would result from the feeder-line-haul system, the study would need to be taken further, looking at a situation where the system is developed and comparing it to existing conditions. This assessment is beyond the scope of this project as it forms part of the next stages of public transport planning.

From the intersection analysis, it was found that there would be time gains resulting from the removal of taxis from the traffic stream within the CBD. The lane groups occupied by taxis show reduced delay when taxis are removed. This would, in the long run, result in the reduction of travel time through the City. Similar to cost saving, time servings would require further investigations and modelling when the network is developed.

CHAPTER 5 CONCLUSIONS

The project was aimed at investigating the feasibility of implementing a feeder line-haul system in the City of Mbombela. This includes placing of stations along major routes at the outskirts of the City where mini-bus taxis will act as feeders to the system and medium sized buses taking over the distribution role. The current public transport system requires that commuters enter the City centre before reaching their final destinations located outside the City centre. The City is rapidly growing outwards while there has not been any change in the public transport to accommodate this. During peak hours, the City experiences congestion and majority of the intersection operate at unacceptable level of service.

In general, the City comprises of a composite grid-diametrical network where major routes leading to the City intersect with or terminate at circular ring lines/roads connecting multiple areas along the boundary of the central district. Some of the major routes can be considered as radial lines since they terminate or intersect at the City centre which results partly into a ring-radial transit network. The composite grid-diametrical network tends to concentrate services towards the Centre of a city, yet it also has a degree of parallel grid-like coverage. This network is ideal for implementation of a feeder-line-haul system and would require reduced infrastructure costs. The study aimed to achieve the following objectives:

- Understand current travelling conditions - destinations, cost and travel time.
- Contribution of mini-bus taxis to delay and or level of service
- Estimate the number of minibus taxis during peak hours
- Estimate passenger demand along corridor
- Consider reduction of mini-bus taxi fleet

5.1 Understanding travel conditions – destinations, cost and travel time

5.1.1 Destinations

An O-D survey was carried out to investigate the current travel conditions faced by commuters. The survey confirmed that around 50% of commuters have their destinations outside the City centre. It can also be concluded that around 50% of commuters change vehicles at least once before reaching their final destination.

5.1.2 Cost of travel

It was also found that passengers spend R896.7 and R953.4 for travel by taxi and bus, respectively. This amounts to around 20% of the salary of passengers falling within the low-income bracket (R86 000.00 per annum). The cost of travel by bus is believed to be too high and requires further validation as it disagrees with findings reported by *Stats SA, 2014*. The financial (out-of-pocket-cost saving) benefit of implementing a feeder-line-haul system can only be assessed when the actual network is developed and could not be concluded as part of this study.

5.1.3 Travel time

Travel time of the respondents generally agree with that reported by *Stats SA (*60 minutes*)*, however, there are passengers who spend up to 2.3 hours per day travelling which is beyond the “time budget” of 1.5 hours per day. Similarly, travel time savings from implementing a feeder-line-haul system can only be assessed when the actual network is developed.

5.2 Contribution of mini-bus taxis to delay and/ or LOS

Intersection analysis found that taxis contribute to congestion and poor level of service on intersection along taxi desire lines. It was found that removing taxis from the traffic stream results in reduced delay along lane groups used by taxis. The reduced delay would therefore improve travelling through the City and result in travel time savings. It was also found that majority of the intersections currently operate at unacceptable levels of service with marginal gains from removal of the taxis indicating that to improve the LOS, detailed analysis would be required to increase their capacity.

5.3 Number of mini-bus taxis during peak hours

Mini-bus taxi counts found that more than 500 mini-bus taxis use the study corridor during morning and afternoon peak hours. The peak hour flow rate is between 84 and 88 taxis/hour with an average headway of between 49 and 58 seconds. The morning peak hour was found to occur between 06:30 and 07:30 AM. It can therefore be concluded that there is a high demand for this mode of public transport within the study area.

5.4 Estimating passenger demand

There is a high number of mini-bus taxis (1200 taxis per day) operating along the Mbombela-Kanyamazane corridor which result to a high passenger demand. The estimated peak demand of 1320 passengers per hour per direction together with demand from the formal bus system and other corridors leading to the City indicate that a feeder-line-haul system is warranted. The study did not cover all corridors leading to the City and therefore, to estimate the total demand, the study would have to be extended to other corridors. Car users that maybe attracted by the proposed system were also not included in the demand estimation since this would require extension of the O-D survey to the current passenger car users.

5.5 Reduction in mini-bus taxi fleet

The study further found that implementation of the proposed feeder-line-haul network would result in reduction in mini-bus taxi fleet (by 30%) and subsequent reduction in operator costs. The system can therefore absorb job opportunities (drivers) lost as a result thereof, where taxi operators can form part of the new system as bus drivers or operational managers.

The findings of the study can feed into the next level of network or operational design, where detailed modelling of the actual feeder-line-haul network is carried out. This can therefore form part of a future study.

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APPENDIX 1: O-D Survey Questionnaire

Survey1

Reason for Travelling

- ○ Work
- ○ School
- ○ Other

Mode of Transport

- ○ Bus
- ○ Taxi

Time of Boarding

hh:mm

Place of Boarding

- ○ Tekwane South Phase 1
- ○ Tekwane South Phase 2
- ○ Lekazi

Do you change vehicles along your route, i,e Transfer?

- ○ Yes
- ○ No

Time of Boarding Next Vehicle

hh:mm

Time of Arrival at final destination

hh:mm

Place of arrival/disembarking?

- Riverside Mall/Industrial
- Ilanga Mall
- West Acres/Belladonna
- The Village/Sonheuwel/Steiltes
- Kamagugu
- Mbombela/Nelspruit CBD
- University of Mpumalanga

Cost of Travel/Trip?

____

APPENDIX 2: Mini-bus Taxi Counts

28-01-2021				02-02-2021			
Number	Time	15 min vol	Headway	Number	Time	15 min vol	Headway
0	00:00:00		0	0	00:00:00		00:00:00
1	00:00:25		00:00:25	1	00:02:30		00:02:30
2	00:01:34		00:01:09	2	00:02:31		00:00:01
3	00:01:57		00:00:23	3	00:03:33		00:01:02
4	00:03:46		00:01:49	4	00:03:41		00:00:08
5	00:04:15		00:00:29	5	00:06:02		00:02:21
6	00:04:53		00:00:38	6	00:06:42		00:00:40
7	00:07:11		00:02:18	7	00:07:38	14.00	00:00:56
8	00:07:17		00:00:06	8	00:09:17		00:01:39
9	00:07:56	19.00	00:00:39	9	00:10:09		00:00:52
10	00:08:18		00:00:22	10	00:11:46		00:01:37
11	00:08:45		00:00:27	11	00:13:16		00:01:30
12	00:09:14		00:00:29	12	00:13:29		00:00:13
13	00:11:19		00:02:05	13	00:13:37		00:00:08
14	00:11:27		00:00:08	14	00:13:40		00:00:03
15	00:12:25		00:00:57	15	00:15:58		00:02:18
16	00:13:04		00:00:39	16	00:16:55		00:00:57
17	00:13:49		00:00:45	17	00:17:02		00:00:07
18	00:13:51		00:00:02	18	00:18:24		00:01:22
19	00:13:53		00:00:02	19	00:18:29		00:00:05
20	00:18:09		00:04:16	20	00:18:30		00:00:01
21	00:18:34		00:00:25	21	00:18:35		00:00:05
22	00:19:10		00:00:36	22	00:18:36		00:00:01
23	00:20:01		00:00:51	23	00:21:21		00:02:45
24	00:22:55		00:02:54	24	00:22:54	20.00	00:01:33
25	00:24:58		00:02:03	25	00:24:09		00:01:15
26	00:25:49	13.00	00:00:51	26	00:24:16		00:00:07
27	00:25:58		00:00:09	27	00:24:43		00:00:27
28	00:26:59		00:01:01	28	00:26:28		00:01:45
29	00:27:30		00:00:31	29	00:26:40		00:00:12
30	00:27:37		00:00:07	30	00:27:30		00:00:50
31	00:28:56		00:01:19	31	00:28:27		00:00:57
32	00:30:01		00:01:05	32	00:29:06		00:00:39
33	00:30:30		00:00:29	33	00:29:20		00:00:14
34	00:31:44		00:01:14	34	00:30:26		00:01:06
35	00:32:18		00:00:34	35	00:32:18		00:01:52
36	00:32:19		00:00:01	36	00:32:37		00:00:19
37	00:35:10		00:02:51	37	00:33:04		00:00:27
38	00:35:35		00:00:25	38	00:33:58		00:00:54
39	00:35:39		00:00:04	39	00:34:07		00:00:09
40	00:35:43		00:00:04	40	00:35:25		00:01:18
41	00:35:51		00:00:08	41	00:35:32		00:00:07
42	00:36:17		00:00:26	42	00:35:59		00:00:27
43	00:36:56		00:00:39	43	00:36:46		00:00:47
44	00:39:54	23.00	00:02:58	44	00:37:14		00:00:28
45	00:40:14		00:00:20	45	00:37:33		00:00:19
46	00:40:31		00:00:17	46	00:38:20		00:00:47
47	00:40:33		00:00:02	47	00:38:43		00:00:23
48	00:40:59		00:00:26	48	00:39:08	26.00	00:00:25
49	00:41:28		00:00:29	49	00:39:27		00:00:19
50	00:41:39		00:00:11	50	00:40:55		00:01:28
51	00:41:45		00:00:06	51	00:41:13		00:00:18
52	00:43:58		00:02:13	52	00:41:39		00:00:26
53	00:44:13		00:00:15	53	00:42:16		00:00:37
54	00:44:15		00:00:02	54	00:42:23		00:00:07
55	00:44:16		00:00:01	55	00:42:28		00:00:05
56	00:45:25		00:01:09	56	00:43:05		00:00:37
57	00:46:28		00:01:03	57	00:43:15		00:00:10
58	00:47:21		00:00:53	58	00:43:19		00:00:04

28-01-2021				02-02-2021			
Number	**Time**	**15 min vol**	**Headway**	**Number**	**Time**	**15 min vol**	**Headway**
59	00:47:27		00:00:06	59	00:43:56		00:00:37
60	00:48:26		00:00:59	60	00:44:54		00:00:58
61	00:48:49		00:00:23	61	00:45:13		00:00:19
62	00:49:18		00:00:29	62	00:46:46		00:01:33
63	00:49:48		00:00:30	63	00:47:07		00:00:21
64	00:50:45		00:00:57	64	00:47:51		00:00:44
65	00:50:54		00:00:09	65	00:48:04		00:00:13
66	00:52:30	20.00	00:01:36	66	00:49:04		00:01:00
67	00:52:55		00:00:25	67	00:50:29		00:01:25
68	00:54:19		00:01:24	68	00:51:38		00:01:09
69	00:54:27		00:00:08	69	00:52:08	18.00	00:00:30
70	00:56:10		00:01:43	70	00:52:24		00:00:16
71	00:57:18		00:01:08	71	00:53:07		00:00:43
72	00:57:42		00:00:24	72	00:53:28		00:00:21
73	00:57:55		00:00:13	73	00:53:50		00:00:22
74	00:59:02		00:01:07	74	00:54:56		00:01:06
75	00:59:58		00:00:56	75	00:56:06		00:01:10
76	01:00:25		00:00:27	76	00:57:20		00:01:14
77	01:01:55		00:01:30	77	00:57:52		00:00:32
78	01:01:56		00:00:01	78	00:58:46		00:00:54
79	01:02:31		00:00:35	79	01:00:47		00:02:01
80	01:02:41		00:00:10	80	01:02:22		00:01:35
81	01:03:20		00:00:39	81	01:03:17		00:00:55
82	01:06:08		00:02:48	82	01:03:24		00:00:07
83	01:06:13		00:00:05	83	01:04:05		00:00:41
84	01:07:14		00:01:01	84	01:04:28		00:00:23
85	01:08:08		00:00:54	85	01:05:02		00:00:34
86	01:08:18	21.00	00:00:10	86	01:05:53		00:00:51
87	01:08:54		00:00:36	87	01:05:54		00:00:01
88	01:09:16		00:00:22	88	01:06:27		00:00:33
89	01:09:59		00:00:43	89	01:07:26		00:00:59
90	01:10:02		00:00:03	90	01:07:45	23.00	00:00:19
91	01:10:58		00:00:56	91	01:07:52		00:00:07
92	01:11:44		00:00:46	92	01:07:53		00:00:01
93	01:13:34		00:01:50	93	01:09:06		00:01:13
94	01:13:55		00:00:21	94	01:09:39		00:00:33
95	01:14:24		00:00:29	95	01:09:41		00:00:02
96	01:14:43		00:00:19	96	01:11:28		00:01:47
97	01:15:15		00:00:32	97	01:11:38		00:00:10
98	01:15:54		00:00:39	98	01:12:38		00:01:00
99	01:16:30		00:00:36	99	01:12:39		00:00:01
100	01:17:22		00:00:52	100	01:12:40		00:00:01
101	01:18:16		00:00:54	101	01:14:54		00:02:14
102	01:18:58		00:00:42	102	01:15:21		00:00:27
103	01:21:06		00:02:08	103	01:15:34		00:00:13
104	01:21:38		00:00:32	104	01:15:59		00:00:25
105	01:22:10		00:00:32	105	01:18:48		00:02:49
106	01:22:42	20.00	00:00:32	106	01:18:50		00:00:02
107	01:23:03		00:00:21	107	01:20:53		00:02:03
108	01:23:35		00:00:32	108	01:21:31		00:00:38
109	01:24:45		00:01:10	109	01:21:35		00:00:04
110	01:24:47		00:00:02	110	01:21:39		00:00:04
111	01:25:11		00:00:24	111	01:21:46		00:00:07
112	01:25:29		00:00:18	112	01:22:08	21.00	00:00:22
113	01:25:45		00:00:16	113	01:22:52		00:00:44
114	01:26:21		00:00:36	114	01:22:57		00:00:05
115	01:27:17		00:00:56	115	01:25:21		00:02:24
116	01:28:16		00:00:59	116	01:25:47		00:00:26
117	01:31:32		00:03:16	117	01:26:24		00:00:37
118	01:32:29		00:00:57	118	01:26:43		00:00:19
119	01:32:47		00:00:18	119	01:27:13		00:00:30

28-01-2021				02-02-2021			
Number	Time	15 min vol	Headway	Number	Time	15 min vol	Headway
120	01:32:49		00:00:02	120	01:29:16		00:02:03
121	01:33:41		00:00:52	121	01:29:45		00:00:29
122	01:33:55		00:00:14	122	01:30:02		00:00:17
123	01:35:36		00:01:41	123	01:30:44		00:00:42
124	01:35:39		00:00:03	124	01:30:47		00:00:03
125	01:35:49	17.00	00:00:10	125	01:31:52		00:01:05
126	01:39:30		00:03:41	126	01:33:03		00:01:11
127	01:39:45		00:00:15	127	01:33:35		00:00:32
128	01:40:02		00:00:17	128	01:33:53		00:00:18
129	01:40:17		00:00:15	129	01:34:26		00:00:33
130	01:43:01		00:02:44	130	01:35:29		00:01:03
131	01:44:05		00:01:04	131	01:36:05		00:00:36
132	01:44:41		00:00:36	132	01:36:53	20.00	00:00:48
133	01:44:47		00:00:06	133	01:37:24		00:00:31
134	01:45:37		00:00:50	134	01:39:33		00:02:09
135	01:47:40		00:02:03	135	01:40:12		00:00:39
136	01:48:00		00:00:20	136	01:40:37		00:00:25
137	01:53:09		00:05:09	137	01:40:51		00:00:14
138	01:53:18		00:00:09	138	01:42:52		00:02:01
139	01:54:54		00:01:36	139	01:43:05		00:00:13
140	01:55:05	14.00	00:00:11	140	01:43:30		00:00:25
141	01:56:20		00:01:15	141	01:44:36		00:01:06
142	01:57:20		00:01:00	142	01:44:39		00:00:03
143	01:57:48		00:00:28	143	01:45:43		00:01:04
144	01:58:19		00:00:31	144	01:45:56		00:00:13
145	01:58:53		00:00:34	145	01:47:09		00:01:13
146	01:58:56		00:00:03	146	01:47:44		00:00:35
147	01:59:25		00:00:29	147	01:48:02		00:00:18
148	02:01:24		00:01:59	148	01:48:13		00:00:11
149	02:01:29		00:00:05	149	01:48:16		00:00:03
150	02:03:24		00:01:55	150	01:48:18		00:00:02
151	02:03:38		00:00:14	151	01:50:47		00:02:29
152	02:03:43		00:00:05	152	01:51:57	20.00	00:01:10
153	02:03:48		00:00:05	153	01:52:35		00:00:38
154	02:03:50		00:00:02	154	01:52:36		00:00:01
155	02:03:52		00:00:02	155	01:52:52		00:00:16
156	02:05:58		00:02:06	156	01:54:25		00:01:33
157	02:06:07	19.00	00:00:09	157	01:55:17		00:00:52
158	02:07:01		00:00:54	158	01:56:47		00:01:30
159	02:09:37		00:02:36	159	01:58:27		00:01:40
160	02:09:39		00:00:02	160	01:58:29		00:00:02
161	02:11:29		00:01:50	161	01:59:18		00:00:49
162	02:11:33		00:00:04	162	01:59:44		00:00:26
163	02:12:14		00:00:41	163	02:02:38		00:02:54
164	02:13:01		00:00:47	164	02:02:57		00:00:19
165	02:14:45		00:01:44	165	02:04:20		00:01:23
166	02:14:57		00:00:12	166	02:04:25		00:00:05
167	02:15:36		00:00:39	167	02:08:31		00:04:06
168	02:17:05		00:01:29	168	02:09:24		00:00:53
169	02:18:04		00:00:59	169	02:10:08		00:00:44
170	02:18:21	8.00	00:00:17	170	02:11:07	15.00	00:00:59
171	02:19:41		00:01:20	171	02:11:08		00:00:01
172	02:20:40		00:00:59	172	02:13:41		00:02:33
173	02:21:30		00:00:50	173	02:14:24		00:00:43
174	02:27:53		00:06:23	174	02:14:25		00:00:01
175	02:32:39		00:04:46	175	02:14:27		00:00:02
176	02:35:59		00:03:20	176	02:14:38		00:00:11
177	02:36:27	5.00	00:00:28	177	02:14:44		00:00:06
178	02:37:18		00:00:51	178	02:16:12		00:01:28
179	02:38:25		00:01:07	179	02:17:44		00:01:32
180	02:49:11		00:10:46	180	02:18:05		00:00:21

28-01-2021				02-02-2021			
Number	**Time**	**15 min vol**	**Headway**	**Number**	**Time**	**15 min vol**	**Headway**
181	02:53:32	8.00	00:04:21	181	02:18:37	11.00	00:00:32
182	02:55:55		00:02:23	182	02:18:47		00:00:10
183	02:56:02		00:00:07	183	02:19:11		00:00:24
184	02:57:41		00:01:39	184	02:19:24		00:00:13
185	02:58:26		00:00:45	185	02:20:24		00:01:00
186	02:58:44		00:00:18	186	02:21:07		00:00:43
187	02:59:59		00:01:15	187	02:21:21		00:00:14
				188	02:27:23		00:06:02
				189	02:33:00	8.00	00:05:37
				190	02:36:19		00:03:19
				191	02:36:34		00:00:15
				192	02:37:29		00:00:55
				193			
				194			
				195			
				196			
				197	02:49:52	12.00	
				198	02:50:54		00:01:02
				199	02:51:47		00:00:53
				200	02:52:28		00:00:41
				201	02:52:34		00:00:06
				202	02:53:13		00:00:39
				203	02:53:27		00:00:14
				204	02:54:04		00:00:37
				205	02:57:32		00:03:28
				206	02:58:56		00:01:24
				207	02:59:56		00:01:00
				208	02:59:57		00:00:01

APPENDIX 3: Intersection Traffic Counts: Peak Hour Flow Rates

CITY OF MBOMBELA

TECHNICAL SERVICES ROADS & STORMWATER

CITY OF MBOMBELA THE ULTIMATE DESTINATION

CITY OF MBOMBELA MASTERPLAN TRAFFIC COUNTS A3 MAPBOOK

Intersection / Year

- ???
- 2010
- 2013
- 2014
- 2016
- 2017
- 2021
- Turning Volumes

N

DATE:	OCTOBER 2021
SCALE: A1	1:3 000
DRAWN:	ENDECON GIS
DESIGN:	TC BOM 2020
PLAN NO.:	CoM RMP 2020
MUNICIPALITY:	City of Mbombela
GEODETIC SYSTEM:	WGS 84 LO 31

0 25 50 100 150
Meters

Please note that this map has been prepared using various data sources and suitable for planning purposes only.

ENDECON UBUNTU (PTY) LTD ENGINEERING CONSULTANTS

APPENDIX 4: Ethics Approval Letter

UNIVERSITEIT
STELLENBOSCH
UNIVERSITY

NOTICE OF APPROVAL

REC: Social, Behavioural and Education Research (SBER) - Initial Application Form

17 November 2020

Project number: 16963

Project Title: Feeder-Linehaul for City of Mbombela: Cost Effective, Feasible Solution

Dear Mr Lucky Mnisi

Your REC: Social, Behavioural and Education Research (SBER) - Initial Application Form submitted on 28 October 2020 was reviewed and approved by the REC: Social, Behavioural and Education Research (REC: SBE).

Please note below expiration date of this approved submission:

Ethics approval period:

Protocol approval date (Humanities)	Protocol expiration date (Humanities)
17 November 2020	16 November 2023

GENERAL REC COMMENTS PERTAINING TO THIS PROJECT:

INVESTIGATOR RESPONSIBILITIES

Please take note of the General Investigator Responsibilities attached to this letter. You may commence with your research after complying fully with these guidelines.

If the researcher deviates in any way from the proposal approved by the REC: SBE, the researcher must notify the REC of these changes.

Please use your SU project number (16963) on any documents or correspondence with the REC concerning your project.

Please note that the REC has the prerogative and authority to ask further questions, seek additional information, require further modifications, or monitor the conduct of your research and the consent process.

CONTINUATION OF PROJECTS AFTER REC APPROVAL PERIOD

You are required to submit a progress report to the REC: SBE before the approval period has expired if a continuation of ethics approval is required. The Committee will then consider the continuation of the project for a further year (if necessary).

Once you have completed your research, you are required to submit a final report to the REC: SBE for review.

Included Documents:

Document Type	File Name	Date	Version
Proof of permission	RE Surveys for you Masters research	13/10/2020	00
Data collection tool	Survey1	13/10/2020	00
Informed Consent Form	SU HUMANITIES Consent template_electronic survey_L Mnisi	18/10/2020	1
Research Protocol/Proposal	PROJECT PROPOSAL_Feader linehaul - Cost effective, feasible solution Rev02	18/10/2020	2
Default	COVID-19 Protocol	18/10/2020	1
Request for permission	Application-Letter-for-Institutional-Permission - Buscor_ L Mnisi	28/10/2020	0
Request for permission	Application-Letter-for-Institutional-Permission- Topstar_ L Mnisi	28/10/2020	0

If you have any questions or need further help, please contact the REC office at cgraham@sun.ac.za.

Sincerely,

Clarissa Graham

REC Coordinator: Research Ethics Committee: Social, Behavioral and Education Research

Principal Investigator Responsibilities

Protection of Human Research Participants

As soon as Research Ethics Committee approval is confirmed by the REC, the principal investigator (PI) is responsible for the following:

Conducting the Research: The PI is responsible for making sure that the research is conducted according to the REC-approved research protocol. The PI is jointly responsible for the conduct of co-investigators and any research staff involved with this research. The PI must ensure that the research is conducted according to the recognised standards of their research field/discipline and according to the principles and standards of ethical research and responsible research conduct.

Participant Enrolment: The PI may not recruit or enrol participants unless the protocol for recruitment is approved by the REC. Recruitment and data collection activities must cease after the expiration date of REC approval. All recruitment materials must be approved by the REC prior to their use.

Informed Consent: The PI is responsible for obtaining and documenting affirmative informed consent using **only** the REC-approved consent documents/process, and for ensuring that no participants are involved in research prior to obtaining their affirmative informed consent. The PI must give all participants copies of the signed informed consent documents, where required. The PI must keep the originals in a secured, REC-approved location for at least five (5) years after the research is complete.

Continuing Review: The REC must review and approve all REC-approved research proposals at intervals appropriate to the degree of risk but not less than once per year. There is **no grace period.** Prior to the date on which the REC approval of the research expires, **it is the PI's responsibility to submit the progress report in a timely fashion to ensure a lapse in REC approval does not occur.** Once REC approval of your research lapses, all research activities must cease, and contact must be made with the REC immediately.

Amendments and Changes: Any planned changes to any aspect of the research (such as research design, procedures, participant population, informed consent document, instruments, surveys or recruiting material, etc.), must be submitted to the REC for review and approval before implementation. Amendments may not be initiated without first obtaining written REC approval. The **only exception** is when it is necessary to eliminate apparent immediate hazards to participants and the REC should be immediately informed of this necessity.

Adverse or Unanticipated Events: Any serious adverse events, participant complaints, and all unanticipated problems that involve risks to participants or others, as well as any research-related injuries, occurring at this institution or at other performance sites must be reported to the REC within **five (5) days** of discovery of the incident. The PI must also report any instances of serious or continuing problems, or non-compliance with the RECs requirements for protecting human research participants.

Research Record Keeping: The PI must keep the following research-related records, at a minimum, in a secure location for a minimum of five years: the REC approved research proposal and all amendments; all informed consent documents; recruiting materials; continuing review reports; adverse or unanticipated events; and all correspondence and approvals from the REC.

Provision of Counselling or emergency support: When a dedicated counsellor or a psychologist provides support to a participant without prior REC review and approval, to the extent permitted by law, such activities will not be recognised as research nor the data used in support of research. Such cases should be indicated in the progress report or final report.

Final reports: When the research is completed (no further participant enrolment, interactions or interventions), the PI must submit a Final Report to the REC to close the study.

On-Site Evaluations, Inspections, or Audits: If the researcher is notified that the research will be reviewed or audited by the sponsor or any other external agency or any internal group, the PI must inform the REC immediately of the impending audit/evaluation.

APPENDIX 5: O-D Survey Results – *Kobotoolbox* output

start	end	Reason for Travelling	Mode of Transport	Time of Boarding	Place of Boarding	Do you change vehicles along your route, i,e Transfer?	Time of Boarding Next Vehicle	Time of Arrival at final destination	Place of arrival/disembarking?	Cost of Travel/Trip?	Transfer?	_id	_uuid	_submission_time	_validation_status	_index
2020-11-10T10:51:21.659+02:00	2020-11-10T10:52:26.385+02:00	Work	Taxi	07:31:00.000+02:00	Tekwane South Phase 1	No		08:00:00.000+02:00	Mbombela/Nelspruit CBD	21		73633560	4261b340-92	2020-11-10T08:52:22		1
2020-11-18T19:38:43.037+02:00	2020-11-18T19:41:47.540+02:00	Work	Taxi	05:15:00.000+02:00	Lekazi	No		06:00:00.000+02:00	Mbombela/Nelspruit CBD	2400		74845400	20b588cc-e9	2020-11-18T17:42:00		2
2020-09-22T13:11:33.759+02:00	2020-09-22T13:18:50.592+02:00	Work	Bus	13:17:00.000+02:00	Tekwane South Phase 1		14:15:00.000+02:00	15:00:00.000+02:00	The Village/Sonheuwel/Steiltes	25.5	Yes	67806402	a5dbd311-ee	2020-09-22T11:19:11		3
2020-09-22T13:18:50.616+02:00	2020-09-22T13:38:19.132+02:00	School	Bus	13:45:00.000+02:00	Tekwane South Phase 1		14:00:00.000+02:00	14:30:00.000+02:00	Riverside Mall/Industrial	18	No	67808813	e11b1c94-07	2020-09-22T11:38:40		4
2020-11-17T11:32:55.051+02:00	2020-11-17T11:34:41.200+02:00	Work	Taxi	11:33:00.000+02:00	Lekazi	Yes	11:55:00.000+02:00	00:50:00.000+02:00	Mbombela/Nelspruit CBD	21		74601095	528cbc00-cd	2020-11-17T09:34:52		5
2020-09-22T13:38:19.146+02:00	2020-09-22T20:25:32.393+02:00	Other	Taxi	20:30:00.000+02:00	Lekazi		21:45:00.000+02:00	21:30:00.000+02:00	The Village/Sonheuwel/Steiltes	16	Yes	67862342	8870eaf2-c7	2020-09-22T18:25:52		6
2020-09-23T14:55:42.125+02:00	2020-09-23T14:57:00.941+02:00	Work	Bus	07:00:00.000+02:00	Tekwane South Phase 1		07:30:00.000+02:00	08:00:00.000+02:00	Riverside Mall/Industrial	40	Yes	67949680	2914a11c-43	2020-09-23T12:57:14		7
2020-09-23T15:07:49.989+02:00	2020-09-23T15:09:46.322+02:00	Work	Taxi	17:08:00.000+02:00	Tekwane South Phase 2		17:09:00.000+02:00	06:09:00.000+02:00	Kamagugu	20	Yes	67951413	bccbc7ed-d6	2020-09-23T13:09:58		8
2020-09-23T15:08:34.720+02:00	2020-09-23T15:11:18.051+02:00	Work	Taxi	14:00:00.000+02:00	Tekwane South Phase 1		14:35:00.000+02:00	15:10:00.000+02:00	Ilanga Mall	25	Yes	67951719	21348de1-62	2020-09-23T13:11:31		9
2020-11-17T10:09:32.576+02:00	2020-11-17T10:11:31.184+02:00	School	Bus	07:15:00.000+02:00	Lekazi	Yes	08:00:00.000+02:00	08:15:00.000+02:00	University of Mpumalanga	20		74587975	684c633c-83	2020-11-17T08:11:44		10
2020-11-12T05:06:44.846+02:00	2020-11-12T05:10:12.316+02:00	Work	Bus	05:07:00.000+02:00	Tekwane South Phase 2	Yes	05:40:00.000+02:00	05:55:00.000+02:00	Riverside Mall/Industrial	50		73922213	d5928315-8d	2020-11-12T03:10:25		11
2020-11-14T16:07:20.468+02:00	2020-11-14T16:09:33.678+02:00	Work	Taxi	11:00:00.000+02:00	Lekazi	No		11:45:00.000+02:00	Mbombela/Nelspruit CBD	21		74587625	0f513ca8-78	2020-11-17T08:09:59		12
2020-11-10T19:29:24.347+02:00	2020-11-10T19:31:54.150+02:00	Other	Taxi	07:00:00.000+02:00	Lekazi	No		07:45:00.000+02:00	Mbombela/Nelspruit CBD	18		73709831	b453fa1e-e6	2020-11-10T17:32:00		13
2020-11-11T07:02:32.858+02:00	2020-11-11T07:06:21.792+02:00	Work	Bus	07:02:00.000+02:00	Tekwane South Phase 1	No		07:35:00.000+02:00	Riverside Mall/Industrial	20		73768448	c07f5625-f3e	2020-11-11T05:06:35		14
2020-11-10T10:11:31.211+02:00	2020-11-10T10:20:09.149+02:00	Work	Taxi	07:45:00.000+02:00	Lekazi	Yes	07:39:00.000+02:00	08:15:00.000+02:00	Mbombela/Nelspruit CBD	22		73629500	cc7cba43-cc	2020-11-10T08:20:20		15
2020-11-10T10:23:18.698+02:00	2020-11-10T10:24:47.728+02:00	Work	Bus	06:50:00.000+02:00	Tekwane South Phase 2	Yes	07:45:00.000+02:00	08:10:00.000+02:00	Riverside Mall/Industrial	593		73629981	e0834872-9c	2020-11-10T08:25:02		16
2020-11-10T10:29:33.552+02:00	2020-11-10T10:31:56.447+02:00	Other	Taxi	11:30:00.000+02:00	Tekwane South Phase 1		15:30:00.000+02:00	16:00:00.000+02:00	Riverside Mall/Industrial	21	Yes	73630757	5a3b2c58-8c	2020-11-10T08:32:09		17
2020-11-10T11:13:29.471+02:00	2020-11-10T11:15:53.455+02:00	Work	Taxi	07:30:00.000+02:00	Tekwane South Phase 2	No		08:00:00.000+02:00	Mbombela/Nelspruit CBD	21		73636461	e093db36-a4	2020-11-10T09:15:50		18
2020-11-10T12:01:43.741+02:00	2020-11-10T12:04:31.569+02:00	Work	Taxi	19:15:00.000+02:00	Tekwane South Phase 2	Yes	19:50:00.000+02:00	20:03:00.000+02:00	The Village/Sonheuwel/Steiltes	21		73642879	a2bacd78-4a	2020-11-10T10:04:41		19
2020-11-10T10:31:56.508+02:00	2020-11-10T20:44:37.314+02:00	Work	Bus	07:00:00.000+02:00	Tekwane South Phase 1	Yes	07:45:00.000+02:00	08:00:00.000+02:00	Riverside Mall/Industrial	30		73719197	3f3c457c-0f3	2020-11-10T18:44:49		20
2020-11-12T06:52:53.080+02:00	2020-11-12T06:55:25.113+02:00	Work	Taxi	10:15:00.000+02:00	Tekwane South Phase 2	Yes	11:00:00.000+02:00	11:14:00.000+02:00	Riverside Mall/Industrial	30		73927455	351260f1-1e	2020-11-12T04:55:19		21
2020-11-12T03:19:24.512+02:00	2020-11-12T16:08:02.326+02:00	School	Bus	07:30:00.000+02:00	Tekwane South Phase 1	No	08:07:00.000+02:00	09:30:00.000+02:00	Mbombela/Nelspruit CBD	250		73993527	da62709a-c5	2020-11-12T14:08:13		22
2020-11-14T16:15:55.791+02:00	2020-11-14T16:17:04.879+02:00	Other	Taxi	14:16:00.000+02:00	Tekwane South Phase 1	No	16:16:00.000+02:00	17:16:00.000+02:00	Mbombela/Nelspruit CBD	21		74264137	c973a33b-f4	2020-11-14T14:17:17		23
2020-11-10T11:15:53.567+02:00	2020-11-14T16:18:58.066+02:00	Work	Taxi	07:30:00.000+02:00	Tekwane South Phase 2	Yes	09:05:00.000+02:00	09:18:00.000+02:00	Riverside Mall/Industrial	21		74264205	81bfe141-68	2020-11-14T14:18:54		24
2020-11-18T05:57:03.338+02:00	2020-11-18T05:58:04.488+02:00	Work	Taxi	06:45:00.000+02:00	Tekwane South Phase 2	No		07:20:00.000+02:00	Mbombela/Nelspruit CBD	21		74732642	12253f9a-49	2020-11-18T03:58:17		25
2020-11-17T09:59:48.720+02:00	2020-11-17T10:00:56.602+02:00	Work	Taxi	08:00:00.000+02:00	Tekwane South Phase 1	No	08:30:00.000+02:00	08:45:00.000+02:00	Riverside Mall/Industrial	40		74586410	2b4f506b-7a	2020-11-17T08:01:00		26
2020-11-17T18:02:26.658+02:00	2020-11-17T18:06:30.617+02:00	School	Taxi	16:00:00.000+02:00	Lekazi	No	18:05:00.000+02:00	16:34:00.000+02:00	University of Mpumalanga	42		74662628	58f8745c-7e	2020-11-17T16:06:42		27
2020-11-17T18:06:14.571+02:00	2020-11-17T18:07:33.456+02:00	Other	Bus	18:06:00.000+02:00	Lekazi	Yes	06:00:00.000+02:00	07:20:00.000+02:00		20		74662754	c2e7bee3-de	2020-11-17T16:07:44		28
2020-11-17T18:05:56.420+02:00	2020-11-17T18:08:04.705+02:00	Work	Bus	17:06:00.000+02:00	Lekazi	Yes	18:07:00.000+02:00	18:10:00.000+02:00	Riverside Mall/Industrial	60		74662872	d403cc09-69	2020-11-17T16:08:16		29
2020-11-17T10:11:31.237+02:00	2020-11-18T08:10:01.712+02:00	School	Bus	07:15:00.000+02:00	Tekwane South Phase 2	Yes	07:45:00.000+02:00	08:05:00.000+02:00	West Acres/Belladonna	20		74741151	78d9caa7-bd	2020-11-18T06:10:15		30
2020-11-18T08:10:01.764+02:00	2020-11-19T17:49:59.104+02:00	Other	Taxi	09:15:00.000+02:00	Lekazi	No		09:47:00.000+02:00	Mbombela/Nelspruit CBD	21		74996948	8d84be9e-68	2020-11-19T15:50:10		31
2020-11-23T11:38:21.212+02:00	2020-11-23T11:40:45.603+02:00	School	Bus	07:10:00.000+02:00	Tekwane South Phase 1	No	07:15:00.000+02:00	07:30:00.000+02:00	West Acres/Belladonna	21		75576552	8cdb42de-6c	2020-11-23T09:40:57		32
2020-11-27T17:48:48.181+02:00	2020-11-27T17:49:49.596+02:00	School	Taxi	06:30:00.000+02:00	Tekwane South Phase 1	Yes	07:00:00.000+02:00	07:30:00.000+02:00	West Acres/Belladonna	21		76428811	ae488d03-de	2020-11-27T15:50:02		33

APPENDIX 6: Intersection Level of Service Analysis Results

APPENDIX 6.1: AM Peak with Mini-bus Taxis

Vistro File: \...\Analysis of intersections in Mbombela.vistro
Report File: N:\...\1. 2021 AM Peak (with taxis).pdf

Scenario 1 2021 AM Peak (with taxis)
2021/11/02

Intersection Analysis Summary

ID	Intersection Name	Control Type	Method	Worst Mvmt	V/C	Delay (s/veh)	LOS
1	D2296/ Friedenheim Rd	Signalized	HCM 6th Edition	NB Left	1,054	170,0	F
3	Kragbron Rd/ Timerhout St	All-way stop	HCM 6th Edition	SB Thru	0,815	24,2	C
6	Bester St/ Corrier St	Signalized	HCM 6th Edition	SB Left	0,586	54,3	D
7	Bester St/ Henshall St.	Signalized	HCM 6th Edition	NB Right	0,616	49,5	D
8	Samora Machel Dr/ Henshall St.	Signalized	HCM 6th Edition	EB Left	0,985	81,2	F
9	Bell St./Henshall St.	Signalized	HCM 6th Edition	SB Right	1,458	253,2	F
10	Andrew St/ Henshall St	All-way stop	HCM 6th Edition	EB Right	0,400	10,5	B
11	Old Pretoria Rd/ Madiba Dr	Signalized	HCM 6th Edition	SB Right	3,834	419,5	F
12	Andrew St/ Paul Kruger St	Two-way stop	HCM 6th Edition	NB Right	0,245	84,3	F

V/C, Delay, LOS: For two-way stop, these values are taken from the movement with the worst (highest) delay value.
For all other control types, they are taken for the whole intersection.

Intersection Level Of Service Report
Intersection 1: D2296/ Friedenheim Rd

Control Type:	Signalized	Delay (sec / veh):	170,0
Analysis Method:	HCM 6th Edition	Level Of Service:	F
Analysis Period:	15 minutes	Volume to Capacity (v/c):	1,054

Intersection Setup

Name	Friedenheim St		D2296		D2296	
Approach	Northbound		Southbound		Westbound	
Lane Configuration						
Turning Movement	Left	Right	Thru	Right	Left	Thru
Lane Width [m]	3,70	3,70	3,70	3,70	3,70	3,70
No. of Lanes in Entry Pocket	0	0	1	0	0	0
Entry Pocket Length [m]	30,48	30,48	60,00	30,48	30,48	30,48
No. of Lanes in Exit Pocket	0	0	0	0	0	0
Exit Pocket Length [m]	0,00	0,00	0,00	0,00	0,00	0,00
Speed [km/h]	48,28		60,00		60,00	
Grade [%]	0,00		0,00		0,00	
Curb Present	No		No		No	
Crosswalk	No		No		No	

Volumes

Name	Friedenheim St		D2296		D2296	
Base Volume Input [veh/h]	908	100	473	66	442	166
Base Volume Adjustment Factor	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000
Heavy Vehicles Percentage [%]	2,00	2,00	2,00	2,00	2,00	2,00
Growth Factor	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000
In-Process Volume [veh/h]	0	0	0	0	0	0
Site-Generated Trips [veh/h]	0	0	0	0	0	0
Diverted Trips [veh/h]	0	0	0	0	0	0
Pass-by Trips [veh/h]	0	0	0	0	0	0
Existing Site Adjustment Volume [veh/h]	0	0	0	0	0	0
Other Volume [veh/h]	0	0	0	0	0	0
Left-Turn on Red Volume [veh/h]	0	0	0	0	0	0
Total Hourly Volume [veh/h]	908	100	473	66	442	166
Peak Hour Factor	0,9500	0,9500	0,9500	0,9500	0,9500	0,9500
Other Adjustment Factor	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000
Total 15-Minute Volume [veh/h]	239	26	124	17	116	44
Total Analysis Volume [veh/h]	956	105	498	69	465	175
Presence of On-Street Parking	No	No	No	No	No	No
On-Street Parking Maneuver Rate [/h]	0	0	0	0	0	0
Local Bus Stopping Rate [/h]	0	0	0	0	0	0
v_do, Outbound Pedestrian Volume crossing	0		0		0	
v_di, Inbound Pedestrian Volume crossing m	0		0		0	
v_co, Outbound Pedestrian Volume crossing	0		0		0	
v_ci, Inbound Pedestrian Volume crossing mi	0		0		0	
v_ab, Corner Pedestrian Volume [ped/h]	0		0		0	
Bicycle Volume [bicycles/h]	0		0		0	

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Version 2021 (SP 0-6)

Intersection Settings

Located in CBD	No
Signal Coordination Group	-
Cycle Length [s]	60
Coordination Type	Time of Day Pattern Coordinated
Actuation Type	Fully actuated
Offset [s]	0,0
Offset Reference	Lead Green - Beginning of First Green
Permissive Mode	SingleBand
Lost time [s]	0,00

Phasing & Timing

Control Type	Permissive	Permissive	Permissive	Permissive	Permissive	Permissive
Signal Group	0	1	2	0	0	4
Auxiliary Signal Groups						
Lead / Lag	-	Lead	-	-	-	-
Minimum Green [s]	0	5	10	0	0	10
Maximum Green [s]	0	30	30	0	0	30
Amber [s]	0,0	3,0	3,0	0,0	0,0	3,0
All red [s]	0,0	1,0	1,0	0,0	0,0	1,0
Split [s]	0	32	14	0	0	14
Vehicle Extension [s]	0,0	3,0	3,0	0,0	0,0	3,0
Walk [s]	0	5	5	0	0	5
Pedestrian Clearance [s]	0	10	10	0	0	10
Delayed Vehicle Green [s]	0,0	0,0	0,0	0,0	0,0	0,0
Rest In Walk		No	No			No
I1, Start-Up Lost Time [s]	0,0	2,0	2,0	0,0	0,0	2,0
I2, Clearance Lost Time [s]	0,0	2,0	2,0	0,0	0,0	2,0
Minimum Recall		No	No			No
Maximum Recall		No	No			No
Pedestrian Recall		No	No			No
Detector Location [m]	0,0	0,0	0,0	0,0	0,0	0,0
Detector Length [m]	0,0	0,0	0,0	0,0	0,0	0,0
I, Upstream Filtering Factor	1,00	1,00	1,00	1,00	1,00	1,00

Exclusive Pedestrian Phase

Pedestrian Signal Group	0
Pedestrian Walk [s]	0
Pedestrian Clearance [s]	0

Lane Group Calculations

Lane Group	L	R	C	C	L	C
C, Cycle Length [s]	85	85	85	85	85	85
L, Total Lost Time per Cycle [s]	4,00	4,00	4,00	4,00	4,00	4,00
l1_p, Permitted Start-Up Lost Time [s]	0,00	0,00	0,00	0,00	0,00	0,00
l2, Clearance Lost Time [s]	2,00	2,00	2,00	2,00	2,00	2,00
g_i, Effective Green Time [s]	30	30	16	16	27	27
g / C, Green / Cycle	0,35	0,35	0,19	0,19	0,32	0,32
(v / s)_i Volume / Saturation Flow Rate	0,60	0,06	0,16	0,16	0,29	0,09
s, saturation flow rate [veh/h]	1589	1781	1702	1848	1589	1870
c, Capacity [veh/h]	562	629	325	353	499	588
d1, Uniform Delay [s]	27,45	18,86	33,05	33,06	28,22	22,03
k, delay calibration	0,50	0,11	0,11	0,11	0,32	0,11
I, Upstream Filtering Factor	1,00	1,00	1,00	1,00	1,00	1,00
d2, Incremental Delay [s]	323,58	0,12	5,62	5,26	19,42	0,28
d3, Initial Queue Delay [s]	0,00	0,00	0,00	0,00	0,00	0,00
Rp, platoon ratio	1,00	1,00	1,00	1,00	1,00	1,00
PF, progression factor	1,00	1,00	1,00	1,00	1,00	1,00

Lane Group Results

X, volume / capacity	1,70	0,17	0,83	0,84	0,93	0,30
d, Delay for Lane Group [s/veh]	351,03	18,99	38,67	38,32	47,64	22,31
Lane Group LOS	F	B	D	D	D	C
Critical Lane Group	Yes	No	No	Yes	Yes	No
50th-Percentile Queue Length [veh/ln]	61,25	1,40	5,64	6,11	11,21	2,55
50th-Percentile Queue Length [m/ln]	466,69	10,70	42,99	46,52	85,44	19,41
95th-Percentile Queue Length [veh/ln]	96,22	2,53	9,54	10,16	16,70	4,59
95th-Percentile Queue Length [m/ln]	733,20	19,27	72,67	77,40	127,29	34,95

Movement, Approach, & Intersection Results

d_M, Delay for Movement [s/veh]	351,03	18,99	38,51	38,32	47,64	22,31
Movement LOS	F	B	D	D	D	C
d_A, Approach Delay [s/veh]	318,17		38,49		40,71	
Approach LOS	F		D		D	
d_I, Intersection Delay [s/veh]	169,96					
Intersection LOS	F					
Intersection V/C	1,054					

Other Modes

g_Walk,mi, Effective Walk Time [s]	0,0	0,0	0,0
M_corner, Corner Circulation Area [m²/ped]	0,00	0,00	0,00
M_CW, Crosswalk Circulation Area [m²/ped]	0,00	0,00	0,00
d_p, Pedestrian Delay [s]	0,00	0,00	0,00
I_p,int, Pedestrian LOS Score for Intersection	0,000	0,000	0,000
Crosswalk LOS	F	F	F
s_b, Saturation Flow Rate of the bicycle lane	2000	2000	2000
c_b, Capacity of the bicycle lane [bicycles/h]	659	235	235
d_b, Bicycle Delay [s]	19,11	33,09	33,09
I_b,int, Bicycle LOS Score for Intersection	1,560	2,027	2,616
Bicycle LOS	A	B	B

Sequence

Ring 1	1	2	-	4	-	-	-	-	-	-	-	-	-	-	-	-
Ring 2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Ring 3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Ring 4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Intersection Level Of Service Report
Intersection 3: Kragbron Rd/ Timerhout St

Control Type:	All-way stop	Delay (sec / veh):	24,2
Analysis Method:	HCM 6th Edition	Level Of Service:	C
Analysis Period:	15 minutes	Volume to Capacity (v/c):	0,815

Intersection Setup

Name	Kragbron Rd			Kragbron Rd			Timerhout St			Timerhout St		
Approach	Northbound			Southbound			Eastbound			Westbound		
Lane Configuration												
Turning Movement	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right
Lane Width [m]	3,70	3,70	3,70	3,70	3,70	3,70	3,70	3,70	3,70	3,70	3,70	3,70
No. of Lanes in Entry Pocket	0	0	0	1	0	0	1	0	0	0	0	0
Entry Pocket Length [m]	30,48	30,48	30,48	110,00	30,48	30,48	60,00	30,48	30,48	30,48	30,48	30,48
No. of Lanes in Exit Pocket	0	0	0	0	0	0	0	0	0	0	0	0
Exit Pocket Length [m]	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
Speed [km/h]	60,00			60,00			60,00			60,00		
Grade [%]	0,00			0,00			0,00			0,00		
Crosswalk	No			No			No			No		

Volumes

Name	Kragbron Rd			Kragbron Rd			Timerhout St			Timerhout St		
Base Volume Input [veh/h]	157	243	9	11	223	216	281	14	54	8	1	9
Base Volume Adjustment Factor	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000
Heavy Vehicles Percentage [%]	2,00	2,00	2,00	2,00	2,00	2,00	2,00	2,00	2,00	2,00	2,00	2,00
Growth Factor	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000
In-Process Volume [veh/h]	0	0	0	0	0	0	0	0	0	0	0	0
Site-Generated Trips [veh/h]	0	0	0	0	0	0	0	0	0	0	0	0
Diverted Trips [veh/h]	0	0	0	0	0	0	0	0	0	0	0	0
Pass-by Trips [veh/h]	0	0	0	0	0	0	0	0	0	0	0	0
Existing Site Adjustment Volume [veh/h]	0	0	0	0	0	0	0	0	0	0	0	0
Other Volume [veh/h]	0	0	0	0	0	0	0	0	0	0	0	0
Total Hourly Volume [veh/h]	157	243	9	11	223	216	281	14	54	8	1	9
Peak Hour Factor	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000
Other Adjustment Factor	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000
Total 15-Minute Volume [veh/h]	39	61	2	3	56	54	70	4	14	2	0	2
Total Analysis Volume [veh/h]	157	243	9	11	223	216	281	14	54	8	1	9
Pedestrian Volume [ped/h]	0			0			0			0		

Intersection Settings

Lanes

Capacity per Entry Lane [veh/h]	564	629	539	557	475	442
Degree of Utilization, x	0,72	0,02	0,81	0,50	0,14	0,04

Movement, Approach, & Intersection Results

95th-Percentile Queue Length [veh]	6,02	0,05	8,03	2,83	0,50	0,13
95th-Percentile Queue Length [m]	45,89	0,41	61,19	21,54	3,79	0,97
Approach Delay [s/veh]	24,34	31,83		14,80		11,48
Approach LOS	C	D		B		B
Intersection Delay [s/veh]	24,18					
Intersection LOS	C					

Intersection Level Of Service Report
Intersection 6: Bester St/ Corrier St

Control Type:	Signalized	Delay (sec / veh):	54,3
Analysis Method:	HCM 6th Edition	Level Of Service:	D
Analysis Period:	15 minutes	Volume to Capacity (v/c):	0,586

Intersection Setup

Name										Timerhout St		
Approach	Northbound			Southbound			Eastbound			Westbound		
Lane Configuration												
Turning Movement	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right
Lane Width [m]	3,70	3,70	3,70	3,70	3,70	3,70	3,70	3,70	3,66	3,66	3,70	3,70
No. of Lanes in Entry Pocket	0	0	0	0	0	1	0	0	0	0	0	1
Entry Pocket Length [m]	30,48	30,48	30,48	30,48	30,48	10,00	30,48	30,48	30,48	30,48	30,48	30,48
No. of Lanes in Exit Pocket	0	0	0	0	0	0	0	0	0	0	0	0
Exit Pocket Length [m]	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
Speed [km/h]	60,00			60,00			60,00			60,00		
Grade [%]	0,00			0,00			0,00			0,00		
Curb Present	No			No			No			No		
Crosswalk	Yes			Yes			Yes			Yes		

Volumes

Name										Timerhout St	
Base Volume Input [veh/h]	109	19	70	179	0	81	53	294	0	0	606	44
Base Volume Adjustment Factor	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000
Heavy Vehicles Percentage [%]	2,00	2,00	2,00	2,00	2,00	2,00	2,00	2,00	2,00	2,00	2,00	2,00
Growth Factor	0,9500	0,9500	0,9500	0,9500	1,0000	0,9500	0,9500	0,9500	1,0000	1,0000	0,9500	0,9500
In-Process Volume [veh/h]	0	0	0	0	0	0	0	0	0	0	0	0
Site-Generated Trips [veh/h]	0	0	0	0	0	0	0	0	0	0	0	0
Diverted Trips [veh/h]	0	0	0	0	0	0	0	0	0	0	0	0
Pass-by Trips [veh/h]	0	0	0	0	0	0	0	0	0	0	0	0
Existing Site Adjustment Volume [veh/h]	0	0	0	0	0	0	0	0	0	0	0	0
Other Volume [veh/h]	0	0	0	0	0	0	0	0	0	0	0	0
Left-Turn on Red Volume [veh/h]	0	0	0	0	0	0	0	0	0	0	0	0
Total Hourly Volume [veh/h]	104	18	67	170	0	77	50	279	0	0	576	42
Peak Hour Factor	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000
Other Adjustment Factor	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000
Total 15-Minute Volume [veh/h]	26	5	17	43	0	19	13	70	0	0	144	11
Total Analysis Volume [veh/h]	104	18	67	170	0	77	50	279	0	0	576	42
Presence of On-Street Parking	No		No	No		No	No		No	No		No
On-Street Parking Maneuver Rate [/h]	0	0	0	0	0	0	0	0	0	0	0	0
Local Bus Stopping Rate [/h]	0	0	0	0	0	0	0	0	0	0	0	0
v_do, Outbound Pedestrian Volume crossing		0			0			0			0	
v_di, Inbound Pedestrian Volume crossing m		0			0			0			0	
v_co, Outbound Pedestrian Volume crossing		0			0			0			0	
v_ci, Inbound Pedestrian Volume crossing mi		0			0			0			0	
v_ab, Corner Pedestrian Volume [ped/h]		0			0			0			0	
Bicycle Volume [bicycles/h]		0			0			0			0	

Generated with PTV VISTRO
Version 2021 (SP 0-6)

Intersection Settings

Located in CBD	Yes
Signal Coordination Group	-
Cycle Length [s]	240
Coordination Type	Time of Day Pattern Coordinated
Actuation Type	Fixed time
Offset [s]	0,0
Offset Reference	Lead Green - Beginning of First Green
Permissive Mode	SingleBand
Lost time [s]	0,00

Phasing & Timing

Control Type	Permiss	Permiss	Permiss	Permiss	Permiss	Permiss	Permiss	Permiss	Permiss	Permiss	Permiss	Permiss
Signal Group	0	6	0	0	0	5	0	8	0	0	4	0
Auxiliary Signal Groups												
Lead / Lag	-	-	-	-	-	Lead	-	-	-	-	-	-
Minimum Green [s]	0	10	0	0	0	5	0	10	0	0	10	0
Maximum Green [s]	0	30	0	0	0	30	0	30	0	0	30	0
Amber [s]	0,0	3,0	0,0	0,0	0,0	3,0	0,0	3,0	0,0	0,0	3,0	0,0
All red [s]	0,0	1,0	0,0	0,0	0,0	1,0	0,0	1,0	0,0	0,0	1,0	0,0
Split [s]	0	53	0	0	0	50	0	137	0	0	137	0
Vehicle Extension [s]	0,0	3,0	0,0	0,0	0,0	3,0	0,0	3,0	0,0	0,0	3,0	0,0
Walk [s]	0	5	0	0	0	5	0	5	0	0	5	0
Pedestrian Clearance [s]	0	12	0	0	0	12	0	12	0	0	6	0
Delayed Vehicle Green [s]	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Rest In Walk		No				No		No			No	
I1, Start-Up Lost Time [s]	0,0	2,0	0,0	0,0	0,0	2,0	0,0	2,0	0,0	0,0	2,0	0,0
I2, Clearance Lost Time [s]	0,0	2,0	0,0	0,0	0,0	2,0	0,0	2,0	0,0	0,0	2,0	0,0
Minimum Recall		No				No		No			No	
Maximum Recall		No				No		No			No	
Pedestrian Recall		No				No		No			No	
Detector Location [m]	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Detector Length [m]	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
I, Upstream Filtering Factor	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00

Exclusive Pedestrian Phase

Pedestrian Signal Group	0
Pedestrian Walk [s]	0
Pedestrian Clearance [s]	0

Lane Group Calculations

Lane Group	C	L	R	L	C	C	R
C, Cycle Length [s]	240	240	240	240	240	240	240
L, Total Lost Time per Cycle [s]	4,00	4,00	4,00	4,00	4,00	4,00	4,00
l1_p, Permitted Start-Up Lost Time [s]	0,00	0,00	0,00	0,00	0,00	0,00	2,00
l2, Clearance Lost Time [s]	2,00	2,00	2,00	2,00	2,00	2,00	2,00
g_i, Effective Green Time [s]	49	46	46	133	133	133	133
g / C, Green / Cycle	0,20	0,19	0,19	0,55	0,55	0,55	0,55
(v / s)_i Volume / Saturation Flow Rate	0,13	0,12	0,05	0,03	0,17	0,34	0,04
s, saturation flow rate [veh/h]	1510	1431	1603	1431	1683	1683	990
c, Capacity [veh/h]	308	274	307	793	933	933	483
d1, Uniform Delay [s]	86,88	88,98	82,37	24,72	28,59	36,26	36,92
k, delay calibration	0,50	0,50	0,50	0,50	0,50	0,50	0,50
I, Upstream Filtering Factor	1,00	1,00	1,00	1,00	1,00	1,00	1,00
d2, Incremental Delay [s]	8,81	10,11	1,95	0,15	0,82	3,06	0,36
d3, Initial Queue Delay [s]	0,00	0,00	0,00	0,00	0,00	0,00	0,00
Rp, platoon ratio	1,00	1,00	1,00	1,00	1,00	1,00	1,00
PF, progression factor	1,00	1,00	1,00	1,00	1,00	1,00	1,00

Lane Group Results

X, volume / capacity	0,61	0,62	0,25	0,06	0,30	0,62	0,09
d, Delay for Lane Group [s/veh]	95,69	99,10	84,31	24,87	29,41	39,33	37,27
Lane Group LOS	F	F	F	C	C	D	D
Critical Lane Group	Yes	Yes	No	No	No	Yes	No
50th-Percentile Queue Length [veh/ln]	11,52	10,55	4,27	1,41	9,08	24,01	1,49
50th-Percentile Queue Length [m/ln]	87,80	80,37	32,50	10,72	69,18	182,93	11,38
95th-Percentile Queue Length [veh/ln]	17,09	15,87	7,65	2,53	14,02	32,04	2,69
95th-Percentile Queue Length [m/ln]	130,22	120,95	58,31	19,30	106,83	244,16	20,49

Movement, Approach, & Intersection Results

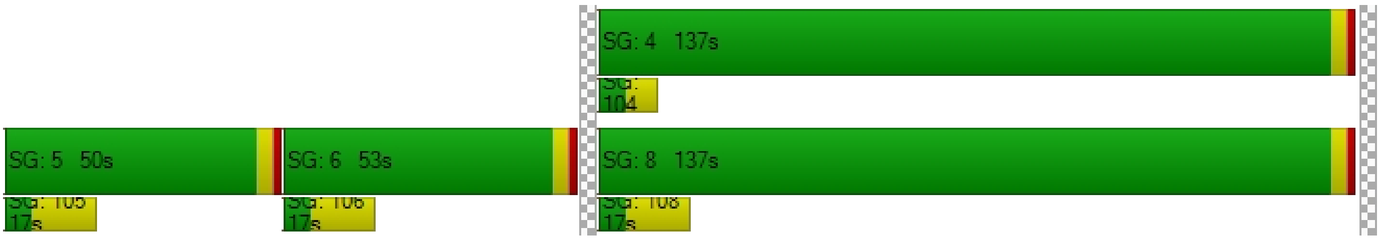
d_M, Delay for Movement [s/veh]	95,69	95,69	95,69	99,10	0,00	84,31	24,87	29,41	0,00	0,00	39,33	37,27
Movement LOS	F	F	F	F		F	C	C			D	D
d_A, Approach Delay [s/veh]	95,69			94,49			28,72			39,19		
Approach LOS	F			F			C			D		
d_I, Intersection Delay [s/veh]	54,30											
Intersection LOS	D											
Intersection V/C	0,586											

Other Modes

g_Walk,mi, Effective Walk Time [s]	9,0	9,0	9,0	9,0
M_corner, Corner Circulation Area [m²/ped]	0,00	0,00	0,00	0,00
M_CW, Crosswalk Circulation Area [m²/ped]	0,00	0,00	0,00	0,00
d_p, Pedestrian Delay [s]	111,17	111,17	111,17	111,17
I_p,int, Pedestrian LOS Score for Intersection	1,945	2,411	2,707	2,724
Crosswalk LOS	A	B	B	B
s_b, Saturation Flow Rate of the bicycle lane	2000	2000	2000	2000
c_b, Capacity of the bicycle lane [bicycles/h]	408	383	1108	1108
d_b, Bicycle Delay [s]	76,00	78,41	23,85	23,85
I_b,int, Bicycle LOS Score for Intersection	1,871	1,670	2,102	2,579
Bicycle LOS	A	A	B	B

Sequence

Ring 1	-	-	-	4	-	-	-	-	-	-	-	-	-	-	-	-
Ring 2	5	6	-	8	-	-	-	-	-	-	-	-	-	-	-	-
Ring 3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Ring 4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-



Intersection Level Of Service Report
Intersection 7: Bester St/ Henshall St.

Control Type:	Signalized	Delay (sec / veh):	49,5
Analysis Method:	HCM 6th Edition	Level Of Service:	D
Analysis Period:	15 minutes	Volume to Capacity (v/c):	0,616

Intersection Setup

Name												
Approach	Northbound			Southbound			Eastbound			Westbound		
Lane Configuration												
Turning Movement	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right
Lane Width [m]	3,70	3,70	3,70	3,70	3,70	3,70	3,66	3,66	3,66	3,70	3,70	3,70
No. of Lanes in Entry Pocket	0	0	0	0	0	0	0	0	0	0	0	0
Entry Pocket Length [m]	30,48	30,48	30,48	30,48	30,48	30,48	30,48	30,48	30,48	30,48	30,48	30,48
No. of Lanes in Exit Pocket	0	0	0	1	0	0	0	0	0	0	0	0
Exit Pocket Length [m]	0,00	0,00	0,00	15,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
Speed [km/h]	60,00			60,00			48,28			60,00		
Grade [%]	0,00			0,00			0,00			0,00		
Curb Present	No			No						No		
Crosswalk	Yes			Yes			Yes			Yes		

Volumes

Name												
Base Volume Input [veh/h]	172	279	167	283	463	120	0	0	0	172	304	239
Base Volume Adjustment Factor	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000
Heavy Vehicles Percentage [%]	2,00	2,00	2,00	2,00	2,00	2,00	2,00	2,00	2,00	2,00	2,00	2,00
Growth Factor	0,9500	0,9500	0,9500	0,9500	0,9500	0,9500	1,0000	1,0000	1,0000	0,9500	0,9500	0,9500
In-Process Volume [veh/h]	0	0	0	0	0	0	0	0	0	0	0	0
Site-Generated Trips [veh/h]	0	0	0	0	0	0	0	0	0	0	0	0
Diverted Trips [veh/h]	0	0	0	0	0	0	0	0	0	0	0	0
Pass-by Trips [veh/h]	0	0	0	0	0	0	0	0	0	0	0	0
Existing Site Adjustment Volume [veh/h]	0	0	0	0	0	0	0	0	0	0	0	0
Other Volume [veh/h]	0	0	0	0	0	0	0	0	0	0	0	0
Left-Turn on Red Volume [veh/h]	0	0	0	0	0	0	0	0	0	0	0	0
Total Hourly Volume [veh/h]	163	265	159	269	440	114	0	0	0	163	289	227
Peak Hour Factor	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000
Other Adjustment Factor	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000
Total 15-Minute Volume [veh/h]	41	66	40	67	110	29	0	0	0	41	72	57
Total Analysis Volume [veh/h]	163	265	159	269	440	114	0	0	0	163	289	227
Presence of On-Street Parking	No		No	No		No				No		No
On-Street Parking Maneuver Rate [/h]	0	0	0	0	0	0	0	0	0	0	0	0
Local Bus Stopping Rate [/h]	0	0	0	0	0	0	0	0	0	0	0	0
v_do, Outbound Pedestrian Volume crossing	0			0			0			0		
v_di, Inbound Pedestrian Volume crossing m	0			0			0			0		
v_co, Outbound Pedestrian Volume crossing	0			0			0			0		
v_ci, Inbound Pedestrian Volume crossing mi	0			0			0			0		
v_ab, Corner Pedestrian Volume [ped/h]	0			0			0			0		
Bicycle Volume [bicycles/h]	0			0			0			0		

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Intersection Settings

Located in CBD	Yes
Signal Coordination Group	-
Cycle Length [s]	240
Coordination Type	Time of Day Pattern Coordinated
Actuation Type	Fixed time
Offset [s]	0,0
Offset Reference	Lead Green - Beginning of First Green
Permissive Mode	SingleBand
Lost time [s]	0,00

Phasing & Timing

Control Type	Permiss	Permiss	Permiss	Permiss	Permiss	Permiss	Permiss	Permiss	Permiss	Permiss	Permiss	Permiss
Signal Group	0	8	0	0	4	0	0	0	0	0	6	0
Auxiliary Signal Groups												
Lead / Lag	-	-	-	-	-	-	-	-	-	-	-	-
Minimum Green [s]	0	10	0	0	10	0	0	0	0	0	10	0
Maximum Green [s]	0	30	0	0	30	0	0	0	0	0	30	0
Amber [s]	0,0	3,0	0,0	0,0	3,0	0,0	0,0	0,0	0,0	0,0	3,0	0,0
All red [s]	0,0	1,0	0,0	0,0	1,0	0,0	0,0	0,0	0,0	0,0	1,0	0,0
Split [s]	0	146	0	0	146	0	0	0	0	0	94	0
Vehicle Extension [s]	0,0	3,0	0,0	0,0	3,0	0,0	0,0	0,0	0,0	0,0	3,0	0,0
Walk [s]	0	5	0	0	5	0	0	0	0	0	5	0
Pedestrian Clearance [s]	0	6	0	0	9	0	0	0	0	0	12	0
Delayed Vehicle Green [s]	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Rest In Walk		No			No						No	
I1, Start-Up Lost Time [s]	0,0	2,0	0,0	0,0	2,0	0,0	0,0	0,0	0,0	0,0	2,0	0,0
I2, Clearance Lost Time [s]	0,0	2,0	0,0	0,0	2,0	0,0	0,0	0,0	0,0	0,0	2,0	0,0
Minimum Recall		No			No						No	
Maximum Recall		No			No						No	
Pedestrian Recall		No			No						No	
Detector Location [m]	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Detector Length [m]	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
I, Upstream Filtering Factor	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00

Exclusive Pedestrian Phase

Pedestrian Signal Group	0
Pedestrian Walk [s]	0
Pedestrian Clearance [s]	0

Lane Group Calculations

Lane Group	C	C	C	C		C	C
C, Cycle Length [s]	240	240	240	240		240	240
L, Total Lost Time per Cycle [s]	4,00	4,00	4,00	4,00		4,00	4,00
l1_p, Permitted Start-Up Lost Time [s]	0,00	2,00	0,00	2,00		0,00	0,00
l2, Clearance Lost Time [s]	2,00	2,00	2,00	2,00		2,00	2,00
g_i, Effective Green Time [s]	142	142	142	142		90	90
g / C, Green / Cycle	0,59	0,59	0,59	0,59		0,38	0,38
(v / s)_i Volume / Saturation Flow Rate	0,30	0,39	0,35	0,36		0,22	0,22
s, saturation flow rate [veh/h]	1435	406	1397	923		1403	1632
c, Capacity [veh/h]	849	270	826	567		526	612
d1, Uniform Delay [s]	28,51	64,35	30,90	49,43		60,43	60,34
k, delay calibration	0,50	0,50	0,50	0,50		0,50	0,50
I, Upstream Filtering Factor	1,00	1,00	1,00	1,00		1,00	1,00
d2, Incremental Delay [s]	2,13	9,06	3,15	4,35		4,95	4,23
d3, Initial Queue Delay [s]	0,00	0,00	0,00	0,00		0,00	0,00
Rp, platoon ratio	1,00	1,00	1,00	1,00		1,00	1,00
PF, progression factor	1,00	1,00	1,00	1,00		1,00	1,00

Lane Group Results

X, volume / capacity	0,50	0,59	0,60	0,58		0,60	0,60
d, Delay for Lane Group [s/veh]	30,65	73,41	34,05	53,78		65,38	64,57
Lane Group LOS	C	E	C	D		E	E
Critical Lane Group	No	Yes	No	No		Yes	No
50th-Percentile Queue Length [veh/ln]	15,15	8,91	18,98	16,22		16,33	18,75
50th-Percentile Queue Length [m/ln]	115,41	67,86	144,59	123,62		124,40	142,87
95th-Percentile Queue Length [veh/ln]	21,53	13,80	26,12	22,83		22,95	25,85
95th-Percentile Queue Length [m/ln]	164,05	105,16	199,03	173,96		174,89	196,99

Movement, Approach, & Intersection Results

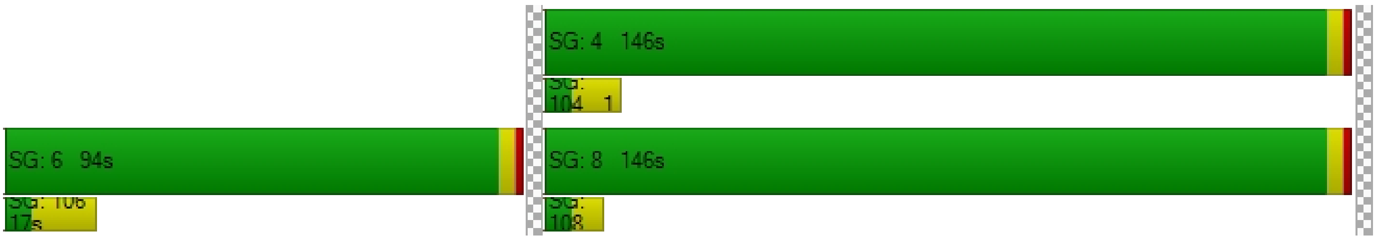
d_M, Delay for Movement [s/veh]	30,65	30,65	73,41	34,05	43,77	53,78	0,00	0,00	0,00	65,38	65,00	64,57
Movement LOS	C	C	E	C	D	D				E	E	E
d_A, Approach Delay [s/veh]	42,23			41,98			0,00			64,95		
Approach LOS	D			D			A			E		
d_I, Intersection Delay [s/veh]	49,52											
Intersection LOS	D											
Intersection V/C	0,616											

Other Modes

g_Walk,mi, Effective Walk Time [s]	9,0	9,0	9,0	9,0
M_corner, Corner Circulation Area [m²/ped]	0,00	0,00	0,00	0,00
M_CW, Crosswalk Circulation Area [m²/ped]	0,00	0,00	0,00	0,00
d_p, Pedestrian Delay [s]	111,17	111,17	111,17	111,17
I_p,int, Pedestrian LOS Score for Intersection	2,757	2,818	2,367	2,943
Crosswalk LOS	C	C	B	C
s_b, Saturation Flow Rate of the bicycle lane	2000	2000	2000	2000
c_b, Capacity of the bicycle lane [bicycles/h]	1183	1183	0	750
d_b, Bicycle Delay [s]	20,01	20,01	120,00	46,88
I_b,int, Bicycle LOS Score for Intersection	2,044	2,239	4,132	2,120
Bicycle LOS	B	B	D	B

Sequence

Ring 1	-	-	-	4	-	-	-	-	-	-	-	-	-	-	-	-
Ring 2	-	6	-	8	-	-	-	-	-	-	-	-	-	-	-	-
Ring 3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Ring 4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-



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Intersection Level Of Service Report
Intersection 8: Samora Machel Dr/ Henshall St.

Control Type:	Signalized	Delay (sec / veh):	81,2
Analysis Method:	HCM 6th Edition	Level Of Service:	F
Analysis Period:	15 minutes	Volume to Capacity (v/c):	0,985

Intersection Setup

Name												
Approach	Northbound			Southbound			Eastbound			Westbound		
Lane Configuration												
Turning Movement	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right
Lane Width [m]	3,66	3,70	3,70	3,70	3,70	3,66	3,70	3,70	3,70	3,66	3,66	3,66
No. of Lanes in Entry Pocket	0	0	0	0	0	0	1	0	1	0	0	0
Entry Pocket Length [m]	30,48	30,48	30,48	30,48	30,48	30,48	100,00	30,48	100,00	30,48	30,48	30,48
No. of Lanes in Exit Pocket	0	0	0	0	0	0	0	0	0	0	0	0
Exit Pocket Length [m]	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
Speed [km/h]	48,28			60,00			60,00			48,28		
Grade [%]	0,00			0,00			0,00			0,00		
Curb Present	No			No			No					
Crosswalk	Yes			Yes			Yes			Yes		

Volumes

Name												
Base Volume Input [veh/h]	0	541	330	225	259	0	387	1121	275	0	0	0
Base Volume Adjustment Factor	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000
Heavy Vehicles Percentage [%]	2,00	2,00	2,00	2,00	2,00	2,00	2,00	2,00	2,00	2,00	2,00	2,00
Growth Factor	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000
In-Process Volume [veh/h]	0	0	0	0	0	0	0	0	0	0	0	0
Site-Generated Trips [veh/h]	0	0	0	0	0	0	0	0	0	0	0	0
Diverted Trips [veh/h]	0	0	0	0	0	0	0	0	0	0	0	0
Pass-by Trips [veh/h]	0	0	0	0	0	0	0	0	0	0	0	0
Existing Site Adjustment Volume [veh/h]	0	0	0	0	0	0	0	0	0	0	0	0
Other Volume [veh/h]	0	0	0	0	0	0	0	0	0	0	0	0
Left-Turn on Red Volume [veh/h]	0	0	0	0	0	0	0	0	0	0	0	0
Total Hourly Volume [veh/h]	0	541	330	225	259	0	387	1121	275	0	0	0
Peak Hour Factor	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000
Other Adjustment Factor	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000
Total 15-Minute Volume [veh/h]	0	135	83	56	65	0	97	280	69	0	0	0
Total Analysis Volume [veh/h]	0	541	330	225	259	0	387	1121	275	0	0	0
Presence of On-Street Parking	No		No	No		No	No		No			
On-Street Parking Maneuver Rate [/h]	0	0	0	0	0	0	0	0	0	0	0	0
Local Bus Stopping Rate [/h]	0	0	0	0	0	0	0	0	0	0	0	0
v_do, Outbound Pedestrian Volume crossing	0			0			0			0		
v_di, Inbound Pedestrian Volume crossing m	0			0			0			0		
v_co, Outbound Pedestrian Volume crossing	0			0			0			0		
v_ci, Inbound Pedestrian Volume crossing mi	0			0			0			0		
v_ab, Corner Pedestrian Volume [ped/h]	0			0			0			0		
Bicycle Volume [bicycles/h]	0			0			0			0		

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Intersection Settings

Located in CBD	Yes
Signal Coordination Group	-
Cycle Length [s]	240
Coordination Type	Time of Day Pattern Coordinated
Actuation Type	Fixed time
Offset [s]	0,0
Offset Reference	Lead Green - Beginning of First Green
Permissive Mode	SingleBand
Lost time [s]	0,00

Phasing & Timing

Control Type	Permiss	Permiss	Permiss	Permiss	Permiss	Permiss	Permiss	Permiss	Permiss	Permiss	Permiss	Permiss
Signal Group	0	6	0	0	2	0	0	8	0	0	0	0
Auxiliary Signal Groups												
Lead / Lag	-	-	-	-	-	-	-	-	-	-	-	-
Minimum Green [s]	0	10	0	0	10	0	0	10	0	0	0	0
Maximum Green [s]	0	30	0	0	30	0	0	30	0	0	0	0
Amber [s]	0,0	3,0	0,0	0,0	3,0	0,0	0,0	3,0	0,0	0,0	0,0	0,0
All red [s]	0,0	1,0	0,0	0,0	1,0	0,0	0,0	1,0	0,0	0,0	0,0	0,0
Split [s]	0	171	0	0	171	0	0	69	0	0	0	0
Vehicle Extension [s]	0,0	3,0	0,0	0,0	3,0	0,0	0,0	3,0	0,0	0,0	0,0	0,0
Walk [s]	0	5	0	0	5	0	0	5	0	0	0	0
Pedestrian Clearance [s]	0	22	0	0	12	0	0	12	0	0	0	0
Delayed Vehicle Green [s]	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Rest In Walk		No			No			No				
I1, Start-Up Lost Time [s]	0,0	2,0	0,0	0,0	2,0	0,0	0,0	2,0	0,0	0,0	0,0	0,0
I2, Clearance Lost Time [s]	0,0	2,0	0,0	0,0	2,0	0,0	0,0	2,0	0,0	0,0	0,0	0,0
Minimum Recall		No			No			No				
Maximum Recall		No			No			No				
Pedestrian Recall		No			No			No				
Detector Location [m]	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Detector Length [m]	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
I, Upstream Filtering Factor	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00

Exclusive Pedestrian Phase

Pedestrian Signal Group	0
Pedestrian Walk [s]	0
Pedestrian Clearance [s]	0

Lane Group Calculations

Lane Group	C	L	C	L	C	R	
C, Cycle Length [s]	240	240	240	240	240	240	
L, Total Lost Time per Cycle [s]	4,00	4,00	4,00	4,00	4,00	4,00	
l1_p, Permitted Start-Up Lost Time [s]	2,00	0,00	0,00	0,00	0,00	0,00	
l2, Clearance Lost Time [s]	2,00	2,00	2,00	2,00	2,00	2,00	
g_i, Effective Green Time [s]	167	167	167	65	65	65	
g / C, Green / Cycle	0,70	0,70	0,70	0,27	0,27	0,27	
(v / s)_i Volume / Saturation Flow Rate	0,71	0,16	0,15	0,27	0,24	0,17	
s, saturation flow rate [veh/h]	1220	1431	1683	1431	4584	1603	
c, Capacity [veh/h]	869	995	1171	387	1242	434	
d1, Uniform Delay [s]	45,94	13,17	13,12	87,46	84,45	77,02	
k, delay calibration	0,50	0,50	0,50	0,50	0,50	0,50	
I, Upstream Filtering Factor	1,00	1,00	1,00	1,00	1,00	1,00	
d2, Incremental Delay [s]	30,96	0,53	0,44	45,45	10,80	6,88	
d3, Initial Queue Delay [s]	0,00	0,00	0,00	0,00	0,00	0,00	
Rp, platoon ratio	1,00	1,00	1,00	1,00	1,00	1,00	
PF, progression factor	1,00	1,00	1,00	1,00	1,00	1,00	

Lane Group Results

X, volume / capacity	1,00	0,23	0,22	1,00	0,90	0,63	
d, Delay for Lane Group [s/veh]	76,91	13,70	13,56	132,91	95,26	83,90	
Lane Group LOS	F	B	B	F	F	F	
Critical Lane Group	Yes	No	No	Yes	No	No	
50th-Percentile Queue Length [veh/ln]	60,86	4,70	5,37	28,97	23,70	15,90	
50th-Percentile Queue Length [m/ln]	463,73	35,83	40,88	220,79	180,56	121,15	
95th-Percentile Queue Length [veh/ln]	73,78	8,26	9,16	37,80	31,68	22,44	
95th-Percentile Queue Length [m/ln]	562,23	62,92	69,83	288,06	241,39	170,98	

Movement, Approach, & Intersection Results

d_M, Delay for Movement [s/veh]	0,00	76,91	76,91	13,70	13,56	0,00	132,91	95,26	83,90	0,00	0,00	0,00
Movement LOS		E	E	B	B		F	F	F			
d_A, Approach Delay [s/veh]	76,91			13,62			101,68			0,00		
Approach LOS	E			B			F			A		
d_I, Intersection Delay [s/veh]	81,22											
Intersection LOS	F											
Intersection V/C	0,985											

Other Modes

g_Walk,mi, Effective Walk Time [s]	9,0	9,0	9,0	9,0
M_corner, Corner Circulation Area [m²/ped]	0,00	0,00	0,00	0,00
M_CW, Crosswalk Circulation Area [m²/ped]	0,00	0,00	0,00	0,00
d_p, Pedestrian Delay [s]	111,17	111,17	111,17	111,17
I_p,int, Pedestrian LOS Score for Intersection	2,721	2,866	3,137	3,304
Crosswalk LOS	B	C	C	C
s_b, Saturation Flow Rate of the bicycle lane	2000	2000	2000	2000
c_b, Capacity of the bicycle lane [bicycles/h]	1392	1392	542	0
d_b, Bicycle Delay [s]	11,10	11,10	63,80	120,00
I_b,int, Bicycle LOS Score for Intersection	2,997	2,358	2,540	4,132
Bicycle LOS	C	B	B	D

Sequence

Ring 1	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Ring 2	-	6	-	8	-	-	-	-	-	-	-	-	-	-	-	-
Ring 3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Ring 4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Intersection Level Of Service Report
Intersection 9: Bell St./Henshall St.

Control Type:	Signalized	Delay (sec / veh):	253,2
Analysis Method:	HCM 6th Edition	Level Of Service:	F
Analysis Period:	15 minutes	Volume to Capacity (v/c):	1,458

Intersection Setup

Name												
Approach	Northbound			Southbound			Eastbound			Westbound		
Lane Configuration												
Turning Movement	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right
Lane Width [m]	3,70	3,70	3,66	3,66	3,70	3,70	3,66	3,66	3,66	3,70	3,70	3,70
No. of Lanes in Entry Pocket	0	0	0	0	0	0	0	0	0	0	0	1
Entry Pocket Length [m]	30,48	30,48	30,48	30,48	30,48	30,48	30,48	30,48	30,48	30,48	30,48	30,48
No. of Lanes in Exit Pocket	0	0	0	0	0	0	0	0	0	0	0	0
Exit Pocket Length [m]	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
Speed [km/h]	60,00			60,00			48,28			60,00		
Grade [%]	0,00			0,00			0,00			0,00		
Curb Present	No			No						No		
Crosswalk	Yes			Yes			Yes			Yes		

Volumes

Name												
Base Volume Input [veh/h]	271	925	0	0	421	254	0	0	0	291	1780	647
Base Volume Adjustment Factor	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000
Heavy Vehicles Percentage [%]	2,00	2,00	2,00	2,00	2,00	2,00	2,00	2,00	2,00	2,00	2,00	2,00
Growth Factor	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000
In-Process Volume [veh/h]	0	0	0	0	0	0	0	0	0	0	0	0
Site-Generated Trips [veh/h]	0	0	0	0	0	0	0	0	0	0	0	0
Diverted Trips [veh/h]	0	0	0	0	0	0	0	0	0	0	0	0
Pass-by Trips [veh/h]	0	0	0	0	0	0	0	0	0	0	0	0
Existing Site Adjustment Volume [veh/h]	0	0	0	0	0	0	0	0	0	0	0	0
Other Volume [veh/h]	0	0	0	0	0	0	0	0	0	0	0	0
Left-Turn on Red Volume [veh/h]	0	0	0	0	0	0	0	0	0	0	0	0
Total Hourly Volume [veh/h]	271	925	0	0	421	254	0	0	0	291	1780	647
Peak Hour Factor	0,9500	0,9500	1,0000	1,0000	0,9500	0,9500	1,0000	1,0000	1,0000	0,9500	0,9500	0,9500
Other Adjustment Factor	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000
Total 15-Minute Volume [veh/h]	71	243	0	0	111	67	0	0	0	77	468	170
Total Analysis Volume [veh/h]	285	974	0	0	443	267	0	0	0	306	1874	681
Presence of On-Street Parking	No		No	No		No				No		No
On-Street Parking Maneuver Rate [/h]	0	0	0	0	0	0	0	0	0	0	0	0
Local Bus Stopping Rate [/h]	0	0	0	0	0	0	0	0	0	0	0	0
v_do, Outbound Pedestrian Volume crossing		0			0			0			0	
v_di, Inbound Pedestrian Volume crossing m		0			0			0			0	
v_co, Outbound Pedestrian Volume crossing		0			0			0			0	
v_ci, Inbound Pedestrian Volume crossing mi		0			0			0			0	
v_ab, Corner Pedestrian Volume [ped/h]		0			0			0			0	
Bicycle Volume [bicycles/h]		0			0			0			0	

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Intersection Settings

Located in CBD	Yes
Signal Coordination Group	-
Cycle Length [s]	60
Coordination Type	Time of Day Pattern Coordinated
Actuation Type	Fixed time
Offset [s]	0,0
Offset Reference	Lead Green - Beginning of First Green
Permissive Mode	SingleBand
Lost time [s]	0,00

Phasing & Timing

Control Type	Permiss	Permiss	Permiss	Permiss	Permiss	Permiss	Permiss	Permiss	Permiss	Permiss	Permiss	Permiss
Signal Group	0	6	0	0	2	0	0	0	0	0	4	0
Auxiliary Signal Groups												
Lead / Lag	-	-	-	-	-	-	-	-	-	-	-	-
Minimum Green [s]	0	10	0	0	10	0	0	0	0	0	10	0
Maximum Green [s]	0	30	0	0	30	0	0	0	0	0	30	0
Amber [s]	0,0	3,0	0,0	0,0	3,0	0,0	0,0	0,0	0,0	0,0	3,0	0,0
All red [s]	0,0	1,0	0,0	0,0	1,0	0,0	0,0	0,0	0,0	0,0	1,0	0,0
Split [s]	0	27	0	0	27	0	0	0	0	0	33	0
Vehicle Extension [s]	0,0	3,0	0,0	0,0	3,0	0,0	0,0	0,0	0,0	0,0	3,0	0,0
Walk [s]	0	5	0	0	5	0	0	0	0	0	5	0
Pedestrian Clearance [s]	0	6	0	0	12	0	0	0	0	0	9	0
Delayed Vehicle Green [s]	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Rest In Walk		No			No						No	
I1, Start-Up Lost Time [s]	0,0	2,0	0,0	0,0	2,0	0,0	0,0	0,0	0,0	0,0	2,0	0,0
I2, Clearance Lost Time [s]	0,0	2,0	0,0	0,0	2,0	0,0	0,0	0,0	0,0	0,0	2,0	0,0
Minimum Recall		No			No						No	
Maximum Recall		No			No						No	
Pedestrian Recall		No			No						No	
Detector Location [m]	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Detector Length [m]	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
I, Upstream Filtering Factor	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00

Exclusive Pedestrian Phase

Pedestrian Signal Group	0
Pedestrian Walk [s]	0
Pedestrian Clearance [s]	0

Lane Group Calculations

Lane Group	C	C	C		C	C	R
C, Cycle Length [s]	60	60	60		60	60	60
L, Total Lost Time per Cycle [s]	4,00	4,00	4,00		4,00	4,00	4,00
l1_p, Permitted Start-Up Lost Time [s]	0,00	0,00	2,00		0,00	0,00	0,00
l2, Clearance Lost Time [s]	2,00	2,00	2,00		2,00	2,00	2,00
g_i, Effective Green Time [s]	23	23	23		29	29	29
g / C, Green / Cycle	0,38	0,38	0,38		0,48	0,48	0,48
(v / s)_i Volume / Saturation Flow Rate	0,78	0,29	10000,00		0,68	0,65	0,42
s, saturation flow rate [veh/h]	1618	1532	0		1604	1683	1603
c, Capacity [veh/h]	620	587	120		775	813	775
d1, Uniform Delay [s]	18,50	16,05	30,00		15,50	15,50	13,92
k, delay calibration	0,50	0,50	0,50		0,50	0,50	0,50
I, Upstream Filtering Factor	1,00	1,00	1,00		1,00	1,00	1,00
d2, Incremental Delay [s]	468,91	8,74	577,27		190,58	161,27	13,52
d3, Initial Queue Delay [s]	0,00	0,00	0,00		0,00	0,00	0,00
Rp, platoon ratio	1,00	1,00	1,00		1,00	1,00	1,00
PF, progression factor	1,00	1,00	1,00		1,00	1,00	1,00

Lane Group Results

X, volume / capacity	2,03	0,75	2,23		1,41	1,34	0,88
d, Delay for Lane Group [s/veh]	487,41	24,79	607,27		206,08	176,77	27,45
Lane Group LOS	F	C	F		F	F	C
Critical Lane Group	Yes	No	No		Yes	No	No
50th-Percentile Queue Length [veh/ln]	87,91	5,83	20,86		49,13	44,94	9,30
50th-Percentile Queue Length [m/ln]	669,87	44,40	158,93		374,34	342,41	70,87
95th-Percentile Queue Length [veh/ln]	141,05	9,79	37,54		75,15	67,71	14,30
95th-Percentile Queue Length [m/ln]	1074,78	74,57	286,07		572,62	515,98	108,98

Movement, Approach, & Intersection Results

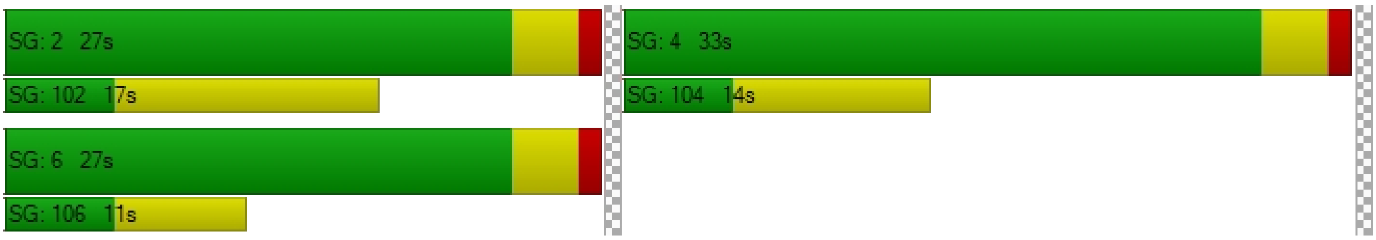
d_M, Delay for Movement [s/veh]	487,41	487,41	0,00	0,00	24,79	607,27	0,00	0,00	0,00	206,08	189,03	27,45
Movement LOS	F	F			C	F				F	F	C
d_A, Approach Delay [s/veh]		487,41			243,83			0,00			152,39	
Approach LOS		F			F			A			F	
d_I, Intersection Delay [s/veh]	253,16											
Intersection LOS	F											
Intersection V/C	1,458											

Other Modes

g_Walk,mi, Effective Walk Time [s]	9,0	9,0	9,0	9,0
M_corner, Corner Circulation Area [m²/ped]	0,00	0,00	0,00	0,00
M_CW, Crosswalk Circulation Area [m²/ped]	0,00	0,00	0,00	0,00
d_p, Pedestrian Delay [s]	21,68	21,68	21,68	21,68
I_p,int, Pedestrian LOS Score for Intersection	3,226	3,458	3,979	3,506
Crosswalk LOS	C	C	D	D
s_b, Saturation Flow Rate of the bicycle lane	2000	2000	2000	2000
c_b, Capacity of the bicycle lane [bicycles/h]	767	767	0	967
d_b, Bicycle Delay [s]	11,41	11,41	30,00	8,01
I_b,int, Bicycle LOS Score for Intersection	3,637	2,145	4,132	3,920
Bicycle LOS	D	B	D	D

Sequence

Ring 1	-	2	-	4	-	-	-	-	-	-	-	-	-	-	-	-
Ring 2	-	6	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Ring 3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Ring 4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-



Intersection Level Of Service Report
Intersection 10: Andrew St/ Henshall St

Control Type:	All-way stop	Delay (sec / veh):	10,5
Analysis Method:	HCM 6th Edition	Level Of Service:	B
Analysis Period:	15 minutes	Volume to Capacity (v/c):	0,400

Intersection Setup

Name						
Approach	Northbound		Eastbound		Westbound	
Lane Configuration						
Turning Movement	Left	Right	Thru	Right	Left	Thru
Lane Width [m]	3,70	3,70	3,70	3,70	3,70	3,70
No. of Lanes in Entry Pocket	0	0	0	1	0	0
Entry Pocket Length [m]	30,48	30,48	30,48	300,00	30,48	30,48
No. of Lanes in Exit Pocket	0	0	0	0	0	0
Exit Pocket Length [m]	0,00	0,00	0,00	0,00	0,00	0,00
Speed [km/h]	60,00		48,28		60,00	
Grade [%]	0,00		0,00		0,00	
Crosswalk	Yes		Yes		Yes	

Volumes

Name						
Base Volume Input [veh/h]	222	53	117	249	1	55
Base Volume Adjustment Factor	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000
Heavy Vehicles Percentage [%]	2,00	2,00	2,00	2,00	2,00	2,00
Growth Factor	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000
In-Process Volume [veh/h]	0	0	0	0	0	0
Site-Generated Trips [veh/h]	0	0	0	0	0	0
Diverted Trips [veh/h]	0	0	0	0	0	0
Pass-by Trips [veh/h]	0	0	0	0	0	0
Existing Site Adjustment Volume [veh/h]	0	0	0	0	0	0
Other Volume [veh/h]	0	0	0	0	0	0
Total Hourly Volume [veh/h]	222	53	117	249	1	55
Peak Hour Factor	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000
Other Adjustment Factor	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000
Total 15-Minute Volume [veh/h]	56	13	29	62	0	14
Total Analysis Volume [veh/h]	222	53	117	249	1	55
Pedestrian Volume [ped/h]	0		0		0	

Intersection Settings

Lanes

Capacity per Entry Lane [veh/h]	793	682	623	694
Degree of Utilization, x	0,35	0,17	0,40	0,08

Movement, Approach, & Intersection Results

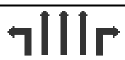
95th-Percentile Queue Length [veh]	1,56	0,62	1,92	0,26
95th-Percentile Queue Length [m]	11,86	4,69	14,63	2,00
Approach Delay [s/veh]	9,94	11,25		8,65
Approach LOS	A	B		A
Intersection Delay [s/veh]	10,52			
Intersection LOS	B			

Generated with PTV VISTRO
Version 2021 (SP 0-6)

Intersection Level Of Service Report
Intersection 11: Old Pretoria Rd/ Madiba Dr

Control Type:	Signalized	Delay (sec / veh):	419,5
Analysis Method:	HCM 6th Edition	Level Of Service:	F
Analysis Period:	15 minutes	Volume to Capacity (v/c):	3,834

Intersection Setup

Name	Madiba Dr			Madiba Dr			Old Pretoria Rd			Old Pretoria Rd		
Approach	Northbound			Southbound			Eastbound			Westbound		
Lane Configuration												
Turning Movement	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right
Lane Width [m]	3,70	3,70	3,70	3,70	3,70	3,70	3,70	3,70	3,70	3,70	3,70	3,70
No. of Lanes in Entry Pocket	1	0	1	1	0	1	1	0	1	1	0	1
Entry Pocket Length [m]	50,00	30,48	90,00	100,00	30,48	60,00	50,00	30,48	60,00	60,00	30,48	100,00
No. of Lanes in Exit Pocket	0	0	0	0	0	0	0	0	0	0	0	0
Exit Pocket Length [m]	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
Speed [km/h]	60,00			60,00			60,00			60,00		
Grade [%]	0,00			0,00			0,00			0,00		
Curb Present	No			No			No			No		
Crosswalk	Yes			Yes			Yes			Yes		

Volumes

Name	Madiba Dr			Madiba Dr			Old Pretoria Rd			Old Pretoria Rd		
Base Volume Input [veh/h]	467	2300	132	1017	2167	629	886	1313	282	113	386	759
Base Volume Adjustment Factor	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000
Heavy Vehicles Percentage [%]	2,00	2,00	2,00	2,00	2,00	2,00	2,00	2,00	2,00	2,00	2,00	2,00
Growth Factor	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000
In-Process Volume [veh/h]	0	0	0	0	0	0	0	0	0	0	0	0
Site-Generated Trips [veh/h]	0	0	0	0	0	0	0	0	0	0	0	0
Diverted Trips [veh/h]	0	0	0	0	0	0	0	0	0	0	0	0
Pass-by Trips [veh/h]	0	0	0	0	0	0	0	0	0	0	0	0
Existing Site Adjustment Volume [veh/h]	0	0	0	0	0	0	0	0	0	0	0	0
Other Volume [veh/h]	0	0	0	0	0	0	0	0	0	0	0	0
Left-Turn on Red Volume [veh/h]	0	0	0	0	0	0	0	0	0	0	0	0
Total Hourly Volume [veh/h]	467	2300	132	1017	2167	629	886	1313	282	113	386	759
Peak Hour Factor	0,9500	0,9500	0,9500	0,9500	0,9500	0,9500	0,9500	0,9500	0,9500	0,9500	0,9500	0,9500
Other Adjustment Factor	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000
Total 15-Minute Volume [veh/h]	123	605	35	268	570	166	233	346	74	30	102	200
Total Analysis Volume [veh/h]	492	2421	139	1071	2281	662	933	1382	297	119	406	799
Presence of On-Street Parking	No		No	No		No	No		No	No		No
On-Street Parking Maneuver Rate [/h]	0	0	0	0	0	0	0	0	0	0	0	0
Local Bus Stopping Rate [/h]	0	0	0	0	0	0	0	0	0	0	0	0
v_do, Outbound Pedestrian Volume crossing	0			0			0			0		
v_di, Inbound Pedestrian Volume crossing m	0			0			0			0		
v_co, Outbound Pedestrian Volume crossing	0			0			0			0		
v_ci, Inbound Pedestrian Volume crossing mi	0			0			0			0		
v_ab, Corner Pedestrian Volume [ped/h]	0			0			0			0		
Bicycle Volume [bicycles/h]	0			0			0			0		

Intersection Settings

Located in CBD	Yes
Signal Coordination Group	-
Cycle Length [s]	70
Coordination Type	Time of Day Pattern Coordinated
Actuation Type	Fixed time
Offset [s]	0,0
Offset Reference	Lead Green - Beginning of First Green
Permissive Mode	SingleBand
Lost time [s]	0,00

Phasing & Timing

Control Type	Permiss	Permiss	Permiss	Permiss	Permiss	Permiss	Permiss	Permiss	Permiss	Permiss	Permiss	Permiss
Signal Group	0	6	0	0	2	0	0	8	0	0	4	0
Auxiliary Signal Groups												
Lead / Lag	-	-	-	-	-	-	-	-	-	-	-	-
Minimum Green [s]	0	10	0	0	10	0	0	10	0	0	10	0
Maximum Green [s]	0	30	0	0	30	0	0	30	0	0	30	0
Amber [s]	0,0	3,0	0,0	0,0	3,0	0,0	0,0	3,0	0,0	0,0	3,0	0,0
All red [s]	0,0	1,0	0,0	0,0	1,0	0,0	0,0	1,0	0,0	0,0	1,0	0,0
Split [s]	0	31	0	0	31	0	0	39	0	0	39	0
Vehicle Extension [s]	0,0	3,0	0,0	0,0	3,0	0,0	0,0	3,0	0,0	0,0	3,0	0,0
Walk [s]	0	5	0	0	5	0	0	5	0	0	5	0
Pedestrian Clearance [s]	0	22	0	0	22	0	0	30	0	0	27	0
Delayed Vehicle Green [s]	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Rest In Walk		No			No			No			No	
I1, Start-Up Lost Time [s]	0,0	2,0	0,0	0,0	2,0	0,0	0,0	2,0	0,0	0,0	2,0	0,0
I2, Clearance Lost Time [s]	0,0	2,0	0,0	0,0	2,0	0,0	0,0	2,0	0,0	0,0	2,0	0,0
Minimum Recall		No			No			No			No	
Maximum Recall		No			No			No			No	
Pedestrian Recall		No			No			No			No	
Detector Location [m]	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Detector Length [m]	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
I, Upstream Filtering Factor	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00

Exclusive Pedestrian Phase

Pedestrian Signal Group	0
Pedestrian Walk [s]	0
Pedestrian Clearance [s]	0

Lane Group Calculations

Lane Group	L	C	R	L	C	R	L	C	R	L	C	R
C, Cycle Length [s]	70	70	70	70	70	70	70	70	70	70	70	70
L, Total Lost Time per Cycle [s]	4,00	4,00	4,00	4,00	4,00	4,00	4,00	4,00	4,00	4,00	4,00	4,00
l1_p, Permitted Start-Up Lost Time [s]	0,00	0,00	2,00	0,00	0,00	2,00	0,00	0,00	2,00	0,00	0,00	2,00
l2, Clearance Lost Time [s]	2,00	2,00	2,00	2,00	2,00	2,00	2,00	2,00	2,00	2,00	2,00	2,00
g_i, Effective Green Time [s]	27	27	27	27	27	27	35	35	35	35	35	35
g / C, Green / Cycle	0,39	0,39	0,39	0,39	0,39	0,39	0,50	0,50	0,50	0,50	0,50	0,50
(v / s)_i Volume / Saturation Flow Rate	0,34	0,53	0,95	0,75	0,50	2,67	0,65	0,43	0,17	0,08	0,13	1,17
s, saturation flow rate [veh/h]	1431	4584	147	1431	4584	248	1431	3204	1711	1431	3204	685
c, Capacity [veh/h]	552	1768	103	552	1768	103	715	1602	785	715	1602	166
d1, Uniform Delay [s]	20,13	21,50	35,00	21,50	21,50	35,00	17,50	15,39	15,30	9,54	10,02	33,77
k, delay calibration	0,50	0,50	0,50	0,50	0,50	0,50	0,50	0,50	0,50	0,50	0,50	0,50
I, Upstream Filtering Factor	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00
d2, Incremental Delay [s]	19,25	169,80	209,04	430,07	134,86	2466,80	147,03	6,39	1,39	0,50	0,38	1729,10
d3, Initial Queue Delay [s]	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
Rp, platoon ratio	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00
PF, progression factor	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00

Lane Group Results

X, volume / capacity	0,89	1,37	1,35	1,94	1,29	6,44	1,30	0,86	0,38	0,17	0,25	4,81
d, Delay for Lane Group [s/veh]	39,38	191,30	244,04	451,57	156,36	2501,80	164,53	21,78	16,69	10,05	10,40	1762,87
Lane Group LOS	D	F	F	F	F	F	F	C	B	B	B	F
Critical Lane Group	No	No	No	No	No	Yes	No	No	No	No	No	Yes
50th-Percentile Queue Length [veh/ln]	9,50	36,18	7,64	73,76	30,46	36,07	38,52	9,33	1,67	0,94	1,60	41,22
50th-Percentile Queue Length [m/ln]	72,37	275,68	58,23	562,05	232,09	274,89	293,54	71,09	12,76	7,20	12,17	314,10
95th-Percentile Queue Length [veh/ln]	14,55	55,36	13,76	118,69	46,12	63,72	58,14	14,34	3,01	1,70	2,88	73,90
95th-Percentile Queue Length [m/ln]	110,88	421,85	104,82	904,45	351,44	485,57	443,05	109,26	22,96	12,95	21,91	563,08

Movement, Approach, & Intersection Results

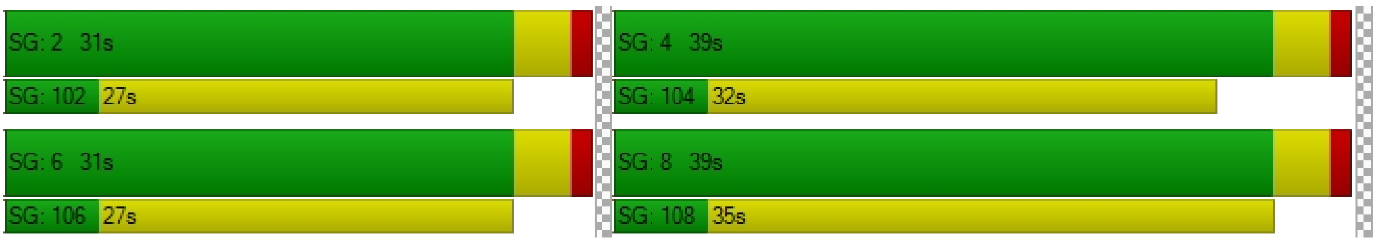
d_M, Delay for Movement [s/veh]	39,38	191,30	244,04	451,57	156,36	2501,80	164,53	21,78	16,69	10,05	10,40	1762,87
Movement LOS	D	F	F	F	F	F	F	C	B	B	B	F
d_A, Approach Delay [s/veh]		169,21			621,94			72,19			1067,94	
Approach LOS		F			F			E			F	
d_I, Intersection Delay [s/veh]						419,51						
Intersection LOS						F						
Intersection V/C						3,834						

Other Modes

g_Walk,mi, Effective Walk Time [s]	9,0	9,0	9,0	9,0
M_corner, Corner Circulation Area [m²/ped]	0,00	0,00	0,00	0,00
M_CW, Crosswalk Circulation Area [m²/ped]	0,00	0,00	0,00	0,00
d_p, Pedestrian Delay [s]	26,58	26,58	26,58	26,58
I_p,int, Pedestrian LOS Score for Intersection	4,538	5,744	4,687	3,871
Crosswalk LOS	E	F	E	D
s_b, Saturation Flow Rate of the bicycle lane	2000	2000	2000	2000
c_b, Capacity of the bicycle lane [bicycles/h]	771	771	1000	1000
d_b, Bicycle Delay [s]	13,21	13,21	8,75	8,75
I_b,int, Bicycle LOS Score for Intersection	3,238	3,767	3,715	2,652
Bicycle LOS	C	D	D	B

Sequence

Ring 1	-	2	-	4	-	-	-	-	-	-	-	-	-	-	-	-
Ring 2	-	6	-	8	-	-	-	-	-	-	-	-	-	-	-	-
Ring 3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Ring 4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-



Intersection Level Of Service Report
Intersection 12: Andrew St/ Paul Kruger St

Control Type:	Two-way stop	Delay (sec / veh):	84,3
Analysis Method:	HCM 6th Edition	Level Of Service:	F
Analysis Period:	15 minutes	Volume to Capacity (v/c):	0,245

Intersection Setup

Name			Old Pretoria Rd			
Approach	Northbound		Eastbound		Westbound	
Lane Configuration						
Turning Movement	Left	Right	Thru	Right	Left	Thru
Lane Width [m]	3,70	3,70	3,70	3,70	3,70	3,70
No. of Lanes in Entry Pocket	1	0	0	0	0	0
Entry Pocket Length [m]	200,00	30,48	30,48	30,48	30,48	30,48
No. of Lanes in Exit Pocket	0	0	0	0	1	0
Exit Pocket Length [m]	0,00	0,00	0,00	0,00	15,00	0,00
Speed [km/h]	60,00		60,00		60,00	
Grade [%]	0,00		0,00		0,00	
Crosswalk	Yes		Yes		Yes	

Volumes

Name			Old Pretoria Rd			
Base Volume Input [veh/h]	503	12	724	328	19	512
Base Volume Adjustment Factor	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000
Heavy Vehicles Percentage [%]	2,00	2,00	2,00	2,00	2,00	2,00
Growth Factor	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000
In-Process Volume [veh/h]	0	0	0	0	0	0
Site-Generated Trips [veh/h]	0	0	0	0	0	0
Diverted Trips [veh/h]	0	0	0	0	0	0
Pass-by Trips [veh/h]	0	0	0	0	0	0
Existing Site Adjustment Volume [veh/h]	0	0	0	0	0	0
Other Volume [veh/h]	0	0	0	0	0	0
Total Hourly Volume [veh/h]	503	12	724	328	19	512
Peak Hour Factor	0,9500	0,9500	0,9500	0,9500	0,9500	0,9500
Other Adjustment Factor	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000
Total 15-Minute Volume [veh/h]	132	3	191	86	5	135
Total Analysis Volume [veh/h]	529	13	762	345	20	539
Pedestrian Volume [ped/h]	0		0		0	

Intersection Settings

Priority Scheme	Stop	Free	Free
Flared Lane			
Storage Area [veh]	0	0	0
Two-Stage Gap Acceptance	No		
Number of Storage Spaces in Median	0	0	0

Movement, Approach, & Intersection Results

V/C, Movement V/C Ratio	0,74	0,24	0,01	0,34	0,00	0,01
d_M, Delay for Movement [s/veh]	17,17	84,30	0,00	10,42	0,00	0,00
Movement LOS	C	F	A	B	A	A
95th-Percentile Queue Length [veh/ln]	2,83	3,90	0,77	1,53	0,00	0,00
95th-Percentile Queue Length [m/ln]	21,57	29,69	5,84	11,68	0,00	0,00
d_A, Approach Delay [s/veh]	18,78		3,25		0,00	
Approach LOS	C		A		A	
d_I, Intersection Delay [s/veh]	6,24					
Intersection LOS	F					

Vistro File: \...\Analysis of intersections in Mbombela.vistro | Scenario 1 2021 AM Peak (with taxis)
Report File: N:\...\1. 2021 AM Peak (with taxis).pdf | 2021/11/02

Turning Movement Volume: Summary

ID	Intersection Name	Northbound		Southbound		Westbound		Total Volume
		Left	Right	Thru	Right	Left	Thru	
1	D2296/ Friedenheim Rd	908	100	473	66	442	166	2155

ID	Intersection Name	Northbound			Southbound			Eastbound			Westbound			Total Volume
		Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	
3	Kragbron Rd/ Timerhout St	157	243	9	11	223	216	281	14	54	8	1	9	1226

ID	Intersection Name	Northbound			Southbound		Eastbound		Westbound		Total Volume
		Left	Thru	Right	Left	Right	Left	Thru	Thru	Right	
6	Bester St/ Corrier St	104	18	67	170	77	50	279	576	42	1383

ID	Intersection Name	Northbound			Southbound			Westbound			Total Volume
		Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	
7	Bester St/ Henshall St.	163	265	159	269	440	114	163	289	227	2089

ID	Intersection Name	Northbound		Southbound		Eastbound			Total Volume
		Thru	Right	Left	Thru	Left	Thru	Right	
8	Samora Machel Dr/ Henshall St.	541	330	225	259	387	1121	275	3138

ID	Intersection Name	Northbound		Southbound		Westbound			Total Volume
		Left	Thru	Thru	Right	Left	Thru	Right	
9	Bell St./Henshall St.	271	925	421	254	291	1780	647	4589

ID	Intersection Name	Northbound		Eastbound		Westbound		Total Volume
		Left	Right	Thru	Right	Left	Thru	
10	Andrew St/ Henshall St	222	53	117	249	1	55	697

ID	Intersection Name	Northbound			Southbound			Eastbound			Westbound			Total Volume
		Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	
11	Old Pretoria Rd/ Madiba Dr	467	2300	132	1017	2167	629	886	1313	282	113	386	759	10451

ID	Intersection Name	Northbound		Eastbound		Westbound		Total Volume
		Left	Right	Thru	Right	Left	Thru	
12	Andrew St/ Paul Kruger St	503	12	724	328	19	512	2098

Vistro File: \...\Analysis of intersections in Mbombela.vistro | Scenario 1 2021 AM Peak (with taxis)
Report File: N:\...\1. 2021 AM Peak (with taxis).pdf | 2021/11/02

Turning Movement Volume: Detail

ID	Intersection Name	Volume Type	Northbound		Southbound		Westbound		Total Volume
			Left	Right	Thru	Right	Left	Thru	
1	D2296/ Friedenheim Rd	Final Base	908	100	473	66	442	166	2155
		Growth Factor	1,00	1,00	1,00	1,00	1,00	1,00	-
		In Process	0	0	0	0	0	0	0
		Net New Trips	0	0	0	0	0	0	0
		Other	0	0	0	0	0	0	0
		Future Total	**908**	**100**	**473**	**66**	**442**	**166**	**2155**

ID	Intersection Name	Volume Type	Northbound			Southbound			Eastbound			Westbound			Total Volume
			Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	
3	Kragbron Rd/ Timerhout St	Final Base	157	243	9	11	223	216	281	14	54	8	1	9	1226
		Growth Factor	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	-
		In Process	0	0	0	0	0	0	0	0	0	0	0	0	0
		Net New Trips	0	0	0	0	0	0	0	0	0	0	0	0	0
		Other	0	0	0	0	0	0	0	0	0	0	0	0	0
		Future Total	**157**	**243**	**9**	**11**	**223**	**216**	**281**	**14**	**54**	**8**	**1**	**9**	**1226**

ID	Intersection Name	Volume Type	Northbound			Southbound		Eastbound		Westbound		Total Volume
			Left	Thru	Right	Left	Right	Left	Thru	Thru	Right	
6	Bester St/ Corrier St	Final Base	109	19	70	179	81	53	294	606	44	1455
		Growth Factor	0,95	0,95	0,95	0,95	0,95	0,95	0,95	0,95	0,95	-
		In Process	0	0	0	0	0	0	0	0	0	0
		Net New Trips	0	0	0	0	0	0	0	0	0	0
		Other	0	0	0	0	0	0	0	0	0	0
		Future Total	**104**	**18**	**67**	**170**	**77**	**50**	**279**	**576**	**42**	**1383**

ID	Intersection Name	Volume Type	Northbound			Southbound			Westbound			Total Volume
			Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	
7	Bester St/ Henshall St.	Final Base	172	279	167	283	463	120	172	304	239	2199
		Growth Factor	0,95	0,95	0,95	0,95	0,95	0,95	0,95	0,95	0,95	-
		In Process	0	0	0	0	0	0	0	0	0	0
		Net New Trips	0	0	0	0	0	0	0	0	0	0
		Other	0	0	0	0	0	0	0	0	0	0
		Future Total	**163**	**265**	**159**	**269**	**440**	**114**	**163**	**289**	**227**	**2089**

ID	Intersection Name	Volume Type	Northbound		Southbound		Eastbound			Total Volume
			Thru	Right	Left	Thru	Left	Thru	Right	
8	Samora Machel Dr/ Henshall St.	Final Base	541	330	225	259	387	1121	275	3138
		Growth Factor	1,00	1,00	1,00	1,00	1,00	1,00	1,00	-
		In Process	0	0	0	0	0	0	0	0
		Net New Trips	0	0	0	0	0	0	0	0
		Other	0	0	0	0	0	0	0	0
		Future Total	**541**	**330**	**225**	**259**	**387**	**1121**	**275**	**3138**

ID	Intersection Name	Volume Type	Northbound		Southbound		Westbound			Total Volume
			Left	Thru	Thru	Right	Left	Thru	Right	
9	Bell St./Henshall St.	Final Base	271	925	421	254	291	1780	647	4589
		Growth Factor	1,00	1,00	1,00	1,00	1,00	1,00	1,00	-
		In Process	0	0	0	0	0	0	0	0
		Net New Trips	0	0	0	0	0	0	0	0
		Other	0	0	0	0	0	0	0	0
		Future Total	**271**	**925**	**421**	**254**	**291**	**1780**	**647**	**4589**

ID	Intersection Name	Volume Type	Northbound		Eastbound		Westbound		Total Volume
			Left	Right	Thru	Right	Left	Thru	
10	Andrew St/ Henshall St	Final Base	222	53	117	249	1	55	697
		Growth Factor	1,00	1,00	1,00	1,00	1,00	1,00	-
		In Process	0	0	0	0	0	0	0
		Net New Trips	0	0	0	0	0	0	0
		Other	0	0	0	0	0	0	0
		Future Total	**222**	**53**	**117**	**249**	**1**	**55**	**697**

ID	Intersection Name	Volume Type	Northbound			Southbound			Eastbound			Westbound			Total Volume
			Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	
11	Old Pretoria Rd/ Madiba Dr	Final Base	467	2300	132	1017	2167	629	886	1313	282	113	386	759	10451
		Growth Factor	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	-
		In Process	0	0	0	0	0	0	0	0	0	0	0	0	0
		Net New Trips	0	0	0	0	0	0	0	0	0	0	0	0	0
		Other	0	0	0	0	0	0	0	0	0	0	0	0	0
		Future Total	**467**	**2300**	**132**	**1017**	**2167**	**629**	**886**	**1313**	**282**	**113**	**386**	**759**	**10451**

ID	Intersection Name	Volume Type	Northbound		Eastbound		Westbound		Total Volume
			Left	Right	Thru	Right	Left	Thru	
12	Andrew St/ Paul Kruger St	Final Base	503	12	724	328	19	512	2098
		Growth Factor	1,00	1,00	1,00	1,00	1,00	1,00	-
		In Process	0	0	0	0	0	0	0
		Net New Trips	0	0	0	0	0	0	0
		Other	0	0	0	0	0	0	0
		Future Total	**503**	**12**	**724**	**328**	**19**	**512**	**2098**

Signal Warrants Report For Intersection 3: Kragbron Rd/ Timerhout St

Warrants Summary

Warrant	Name	Met?
#1	Eight Hour Vehicular Volume	Yes
#2	Four Hour Vehicular Volume	Yes
#3	Peak Hour	Yes

Intersection Warrants Parameters

Major Approaches	S, N
Minor Approaches	E, W
Speed > 40mph	Yes
Population < 10,000	No
Warrant Factor	70%

Warrant Analysis Traffic Volumes

Hour	Major Streets		Minor Streets	
	S	N	E	W
1	409	450	18	349
2	397	437	17	339
3	389	428	17	332
4	364	401	16	311
5	323	356	14	276
6	319	351	14	272
7	315	347	14	269
8	286	315	13	244
9	282	311	12	241
10	278	306	12	237
11	241	266	11	206
12	225	248	10	192
13	221	243	10	188
14	164	180	7	140
15	164	180	7	140
16	115	126	5	98
17	65	72	3	56
18	65	72	3	56
19	37	41	2	31
20	20	23	1	17
21	12	14	1	10
22	4	5	0	3
23	4	5	0	3
24	4	5	0	3

Warrant Analysis by Hour

Hour	Major Streets		Minor Street		Warrant 1 Condition A				Warrant 1 Condition B				Warrant 2	Warrant 3
	Number	Volume	Number	Volume	100%	80%	70%	56%	100%	80%	70%	56%		Condition B
1	2	859	2	349	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes
2	2	834	2	339	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes
3	2	817	2	332	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes
4	2	765	2	311	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes
5	2	679	2	276	Yes	Yes	Yes	Yes	No	No	Yes	Yes	Yes	Yes
6	2	670	2	272	Yes	Yes	Yes	Yes	No	No	Yes	Yes	Yes	No
7	2	662	2	269	Yes	Yes	Yes	Yes	No	No	Yes	Yes	Yes	No
8	2	601	2	244	Yes	Yes	Yes	Yes	No	No	No	Yes	Yes	No
9	2	593	2	241	No	Yes	Yes	Yes	No	No	No	Yes	Yes	No
10	2	584	2	237	No	Yes	Yes	Yes	No	No	No	Yes	Yes	No
11	2	507	2	206	No	Yes	Yes	Yes	No	No	No	Yes	No	No
12	2	473	2	192	No	No	Yes	Yes	No	No	No	No	No	No
13	2	464	2	188	No	No	Yes	Yes	No	No	No	No	No	No
14	2	344	2	140	No	No	No	Yes	No	No	No	No	No	No
15	2	344	2	140	No	No	No	Yes	No	No	No	No	No	No
16	2	241	2	98	No	No	No	No	No	No	No	No	No	No
17	2	137	2	56	No	No	No	No	No	No	No	No	No	No
18	2	137	2	56	No	No	No	No	No	No	No	No	No	No
19	2	78	2	31	No	No	No	No	No	No	No	No	No	No
20	2	43	2	17	No	No	No	No	No	No	No	No	No	No
21	2	26	2	10	No	No	No	No	No	No	No	No	No	No
22	2	9	2	3	No	No	No	No	No	No	No	No	No	No
23	2	9	2	3	No	No	No	No	No	No	No	No	No	No
24	2	9	2	3	No	No	No	No	No	No	No	No	No	No
Hours Met					8	11	13	15	0	4	7	11	10	5

Warrant 3 Condition A

Orientation	E	W
Total Stopped Delay Per Vehicle on Minor Approach (s)	11,5	14,8
Number of Lanes on Minor Street Approach	1	2
VehicleHours of Stopped Delay on Minor Approach ([h]h:mm)	0:03	1:26
Delay Condition Met	No	No
Volume on Minor Street Approach During Same Hour	18	349
High Minor Volume Condition Met	No	Yes
Total Entering Volume on All Approaches During Same Hour	1226	1226
Number of Approaches on Intersection	4	4
Total Volume Condition Met	Yes	Yes
Warrant Met for Approach	No	No
Warrant Met for Intersection	**No**	

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Version 2021 (SP 0-6)

Signal Warrants Report For Intersection 10: Andrew St/ Henshall St

Warrants Summary

Warrant	Name	Met?
#1	Eight Hour Vehicular Volume	No
#2	Four Hour Vehicular Volume	No
#3	Peak Hour	No

Intersection Warrants Parameters

Major Approaches	S, W
Minor Approaches	E
Speed > 40mph	Yes
Population < 10,000	No
Warrant Factor	70%

Warrant Analysis Traffic Volumes

Hour	Major Streets		Minor Streets
	S	W	E
1	275	366	56
2	267	355	54
3	261	348	53
4	245	326	50
5	217	289	44
6	215	285	44
7	212	282	43
8	193	256	39
9	190	253	39
10	187	249	38
11	162	216	33
12	151	201	31
13	149	198	30
14	110	146	22
15	110	146	22
16	77	102	16
17	44	59	9
18	44	59	9
19	25	33	5
20	14	18	3
21	8	11	2
22	3	4	1
23	3	4	1
24	3	4	1

Warrant Analysis by Hour

Hour	Major Streets		Minor Street		Warrant 1 Condition A				Warrant 1 Condition B				Warrant 2	Warrant 3
	Number	Volume	Number	Volume	100%	80%	70%	56%	100%	80%	70%	56%		Condition B
1	2	641	1	56	No	No	No	No	No	No	Yes	Yes	No	No
2	2	622	1	54	No	No	No	No	No	No	No	Yes	No	No
3	2	609	1	53	No	No	No	No	No	No	No	Yes	No	No
4	2	571	1	50	No	No	No	No	No	No	No	Yes	No	No
5	2	506	1	44	No	No	No	No	No	No	No	Yes	No	No
6	2	500	1	44	No	No	No	No	No	No	No	No	No	No
7	2	494	1	43	No	No	No	No	No	No	No	No	No	No
8	2	449	1	39	No	No	No	No	No	No	No	No	No	No
9	2	443	1	39	No	No	No	No	No	No	No	No	No	No
10	2	436	1	38	No	No	No	No	No	No	No	No	No	No
11	2	378	1	33	No	No	No	No	No	No	No	No	No	No
12	2	352	1	31	No	No	No	No	No	No	No	No	No	No
13	2	347	1	30	No	No	No	No	No	No	No	No	No	No
14	2	256	1	22	No	No	No	No	No	No	No	No	No	No
15	2	256	1	22	No	No	No	No	No	No	No	No	No	No
16	2	179	1	16	No	No	No	No	No	No	No	No	No	No
17	2	103	1	9	No	No	No	No	No	No	No	No	No	No
18	2	103	1	9	No	No	No	No	No	No	No	No	No	No
19	2	58	1	5	No	No	No	No	No	No	No	No	No	No
20	2	32	1	3	No	No	No	No	No	No	No	No	No	No
21	2	19	1	2	No	No	No	No	No	No	No	No	No	No
22	2	7	1	1	No	No	No	No	No	No	No	No	No	No
23	2	7	1	1	No	No	No	No	No	No	No	No	No	No
24	2	7	1	1	No	No	No	No	No	No	No	No	No	No
Hours Met					0	0	0	0	0	0	1	5	0	0

Warrant 3 Condition A

Orientation	E
Total Stopped Delay Per Vehicle on Minor Approach (s)	8,6
Number of Lanes on Minor Street Approach	1
VehicleHours of Stopped Delay on Minor Approach ([h]h:mm)	0:08
Delay Condition Met	No
Volume on Minor Street Approach During Same Hour	56
High Minor Volume Condition Met	No
Total Entering Volume on All Approaches During Same Hour	697
Number of Approaches on Intersection	3
Total Volume Condition Met	Yes
Warrant Met for Approach	No
Warrant Met for Intersection	**No**

Signal Warrants Report For Intersection 12: Andrew St/ Paul Kruger St

Warrants Summary

Warrant	Name	Met?
#1	Eight Hour Vehicular Volume	Yes
#2	Four Hour Vehicular Volume	Yes
#3	Peak Hour	Yes

Intersection Warrants Parameters

Major Approaches	E, W
Minor Approaches	S
Speed > 40mph	Yes
Population < 10,000	No
Warrant Factor	70%

Warrant Analysis Traffic Volumes

Hour	Major Streets		Minor Streets
	E	W	S
1	531	1052	515
2	515	1020	500
3	504	999	489
4	473	936	458
5	419	831	407
6	414	821	402
7	409	810	397
8	372	736	361
9	366	726	355
10	361	715	350
11	313	621	304
12	292	579	283
13	287	568	278
14	212	421	206
15	212	421	206
16	149	295	144
17	85	168	82
18	85	168	82
19	48	95	46
20	27	53	26
21	16	32	15
22	5	11	5
23	5	11	5
24	5	11	5

Warrant Analysis by Hour

Hour	Major Streets		Minor Street		Warrant 1 Condition A				Warrant 1 Condition B				Warrant 2	Warrant 3
	Number	Volume	Number	Volume	100%	80%	70%	56%	100%	80%	70%	56%		Condition B
1	2	1583	2	515	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
2	2	1535	2	500	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
3	2	1503	2	489	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
4	2	1409	2	458	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
5	2	1250	2	407	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
6	2	1235	2	402	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
7	2	1219	2	397	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
8	2	1108	2	361	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
9	2	1092	2	355	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
10	2	1076	2	350	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
11	2	934	2	304	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
12	2	871	2	283	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes
13	2	855	2	278	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes
14	2	633	2	206	Yes	Yes	Yes	Yes	No	No	Yes	Yes	Yes	No
15	2	633	2	206	Yes	Yes	Yes	Yes	No	No	Yes	Yes	Yes	No
16	2	444	2	144	No	No	Yes	Yes	No	No	No	No	No	No
17	2	253	2	82	No	No	No	No	No	No	No	No	No	No
18	2	253	2	82	No	No	No	No	No	No	No	No	No	No
19	2	143	2	46	No	No	No	No	No	No	No	No	No	No
20	2	80	2	26	No	No	No	No	No	No	No	No	No	No
21	2	48	2	15	No	No	No	No	No	No	No	No	No	No
22	2	16	2	5	No	No	No	No	No	No	No	No	No	No
23	2	16	2	5	No	No	No	No	No	No	No	No	No	No
24	2	16	2	5	No	No	No	No	No	No	No	No	No	No
Hours Met					15	15	16	16	11	13	15	15	15	13

Warrant 3 Condition A

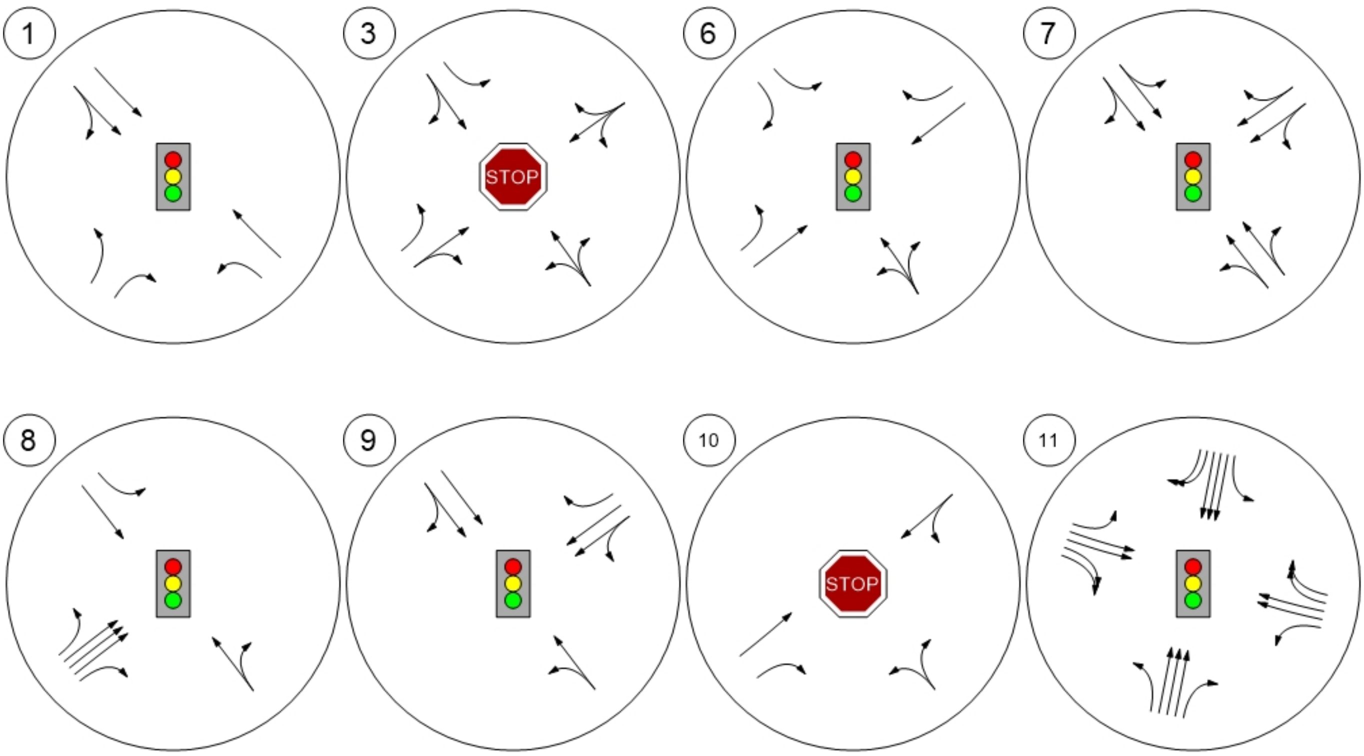
Orientation	S
Total Stopped Delay Per Vehicle on Minor Approach (s)	18,8
Number of Lanes on Minor Street Approach	2
VehicleHours of Stopped Delay on Minor Approach ([h]h:mm)	2:41
Delay Condition Met	No
Volume on Minor Street Approach During Same Hour	515
High Minor Volume Condition Met	Yes
Total Entering Volume on All Approaches During Same Hour	2098
Number of Approaches on Intersection	3
Total Volume Condition Met	Yes
Warrant Met for Approach	No
Warrant Met for Intersection	**No**

Study Intersections

Generated with PTV VISTRO

Version 2021 (SP 0-6)

Lane Configuration and Traffic Control



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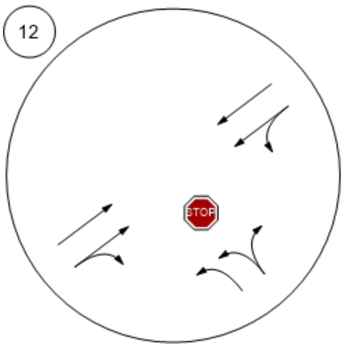
Version 2021 (SP 0-6)

Lane Configuration and Traffic Control



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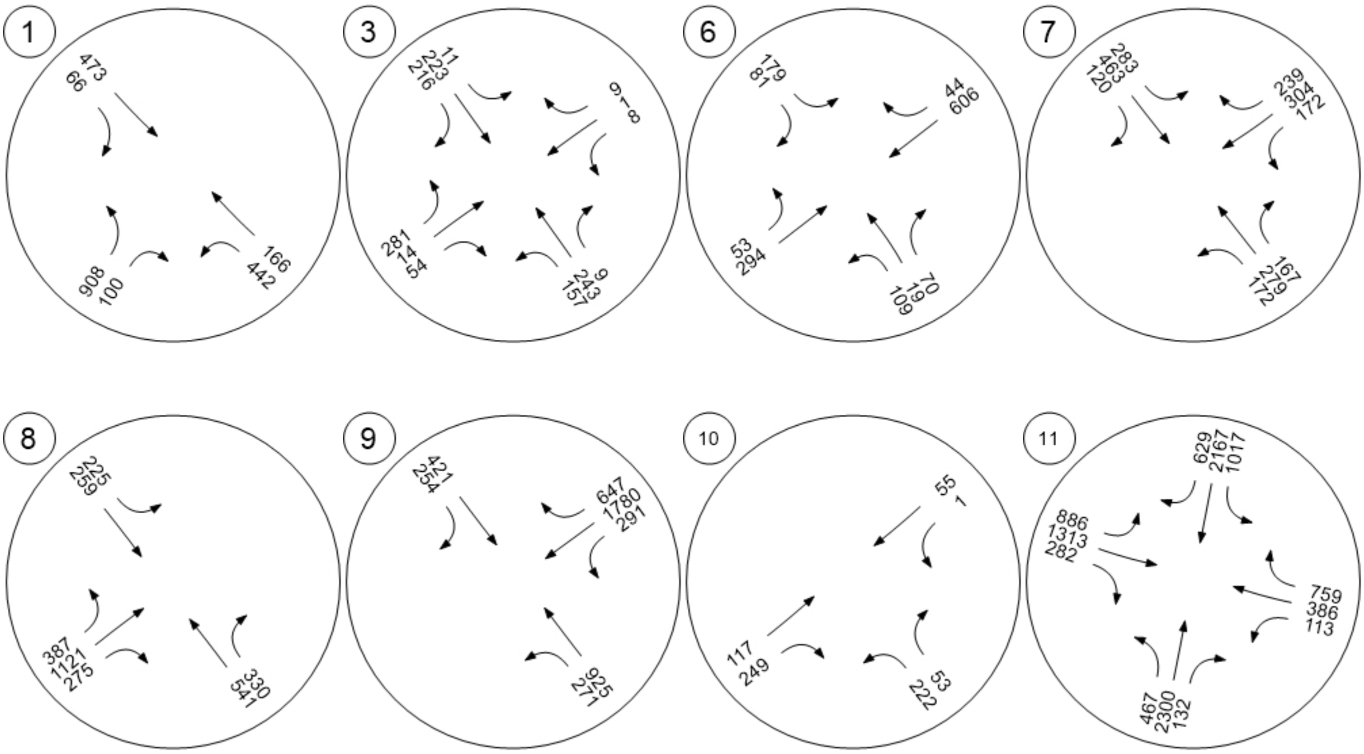
Version 2021 (SP 0-6)

Traffic Volume - Base Volume



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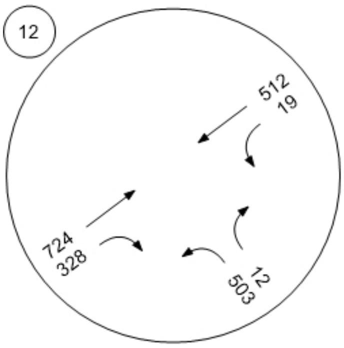
Version 2021 (SP 0-6)

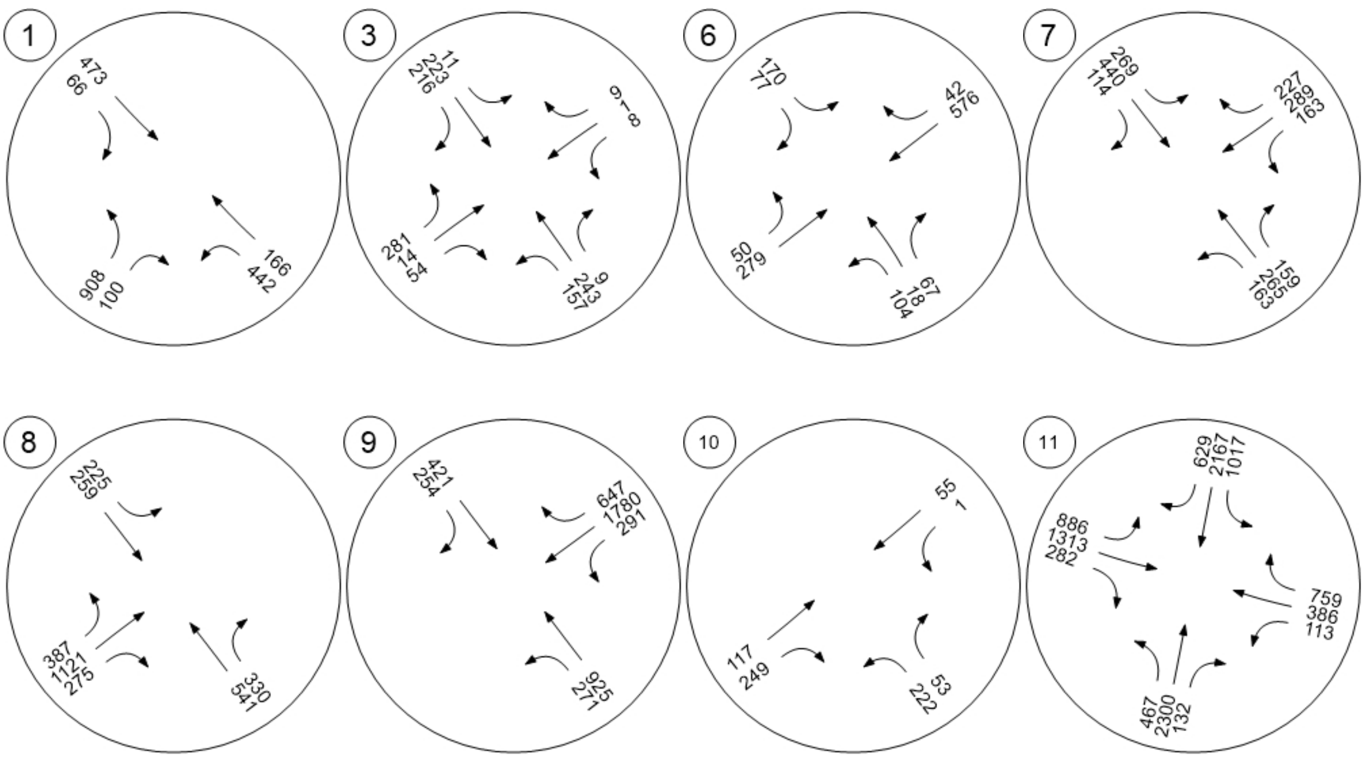
Traffic Volume - Base Volume



Generated with PTV VISTRO

Version 2021 (SP 0-6)

Traffic Volume - Future Total Volume



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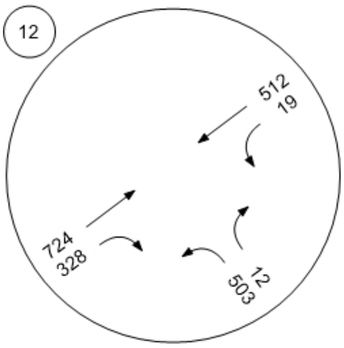
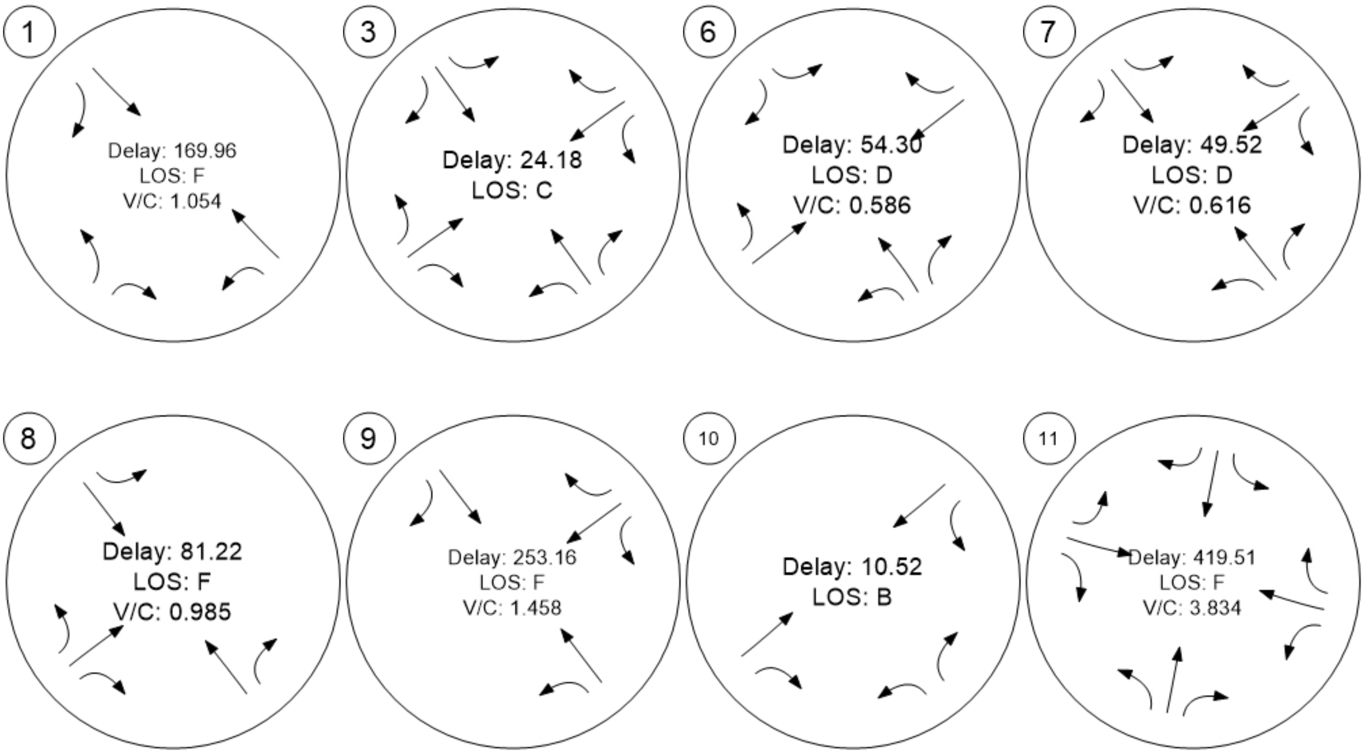
Version 2021 (SP 0-6)

Traffic Volume - Future Total Volume



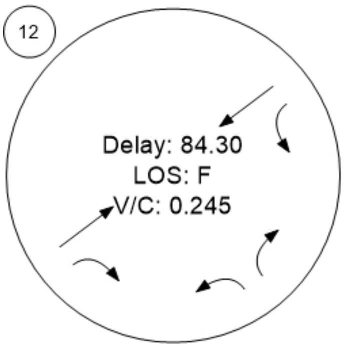
Traffic Conditions



Generated with PTV VISTRO

Version 2021 (SP 0-6)

Traffic Conditions



APPENDIX 6.2: AM Peak without Mini-bus Taxis

Vistro File: \...\Analysis of intersections in Mbombela.vistro
Report File: N:\...\2. 2021 AM Peak (without taxis).pdf

Scenario 2 2021 AM Peak (without taxis)
2021/11/02

Intersection Analysis Summary

ID	Intersection Name	Control Type	Method	Worst Mvmt	V/C	Delay (s/veh)	LOS
1	D2296/ Friedenheim Rd	Signalized	HCM 6th Edition	NB Left	0,940	112,2	F
3	Kragbron Rd/ Timerhout St	All-way stop	HCM 6th Edition	SB Thru	0,703	18,6	C
6	Bester St/ Corrier St	Signalized	HCM 6th Edition	SB Left	0,526	53,4	D
7	Bester St/ Henshall St.	Signalized	HCM 6th Edition	NB Right	0,541	47,0	D
8	Samora Machel Dr/ Henshall St.	Signalized	HCM 6th Edition	EB Left	0,943	74,8	E
9	Bell St./Henshall St.	Signalized	HCM 6th Edition	SB Right	1,458	256,4	F
10	Andrew St/ Henshall St	All-way stop	HCM 6th Edition	EB Right	0,342	9,8	A
11	Old Pretoria Rd/ Madiba Dr	Signalized	HCM 6th Edition	SB Right	3,684	378,4	F
12	Andrew St/ Paul Kruger St	Two-way stop	HCM 6th Edition	NB Right	0,191	65,6	F

V/C, Delay, LOS: For two-way stop, these values are taken from the movement with the worst (highest) delay value.
For all other control types, they are taken for the whole intersection.

Intersection Level Of Service Report
Intersection 1: D2296/ Friedenheim Rd

Control Type:	Signalized	Delay (sec / veh):	112,2
Analysis Method:	HCM 6th Edition	Level Of Service:	F
Analysis Period:	15 minutes	Volume to Capacity (v/c):	0,940

Intersection Setup

Name	Friedenheim St		D2296		D2296	
Approach	Northbound		Southbound		Westbound	
Lane Configuration						
Turning Movement	Left	Right	Thru	Right	Left	Thru
Lane Width [m]	3,70	3,70	3,70	3,70	3,70	3,70
No. of Lanes in Entry Pocket	0	0	1	0	0	0
Entry Pocket Length [m]	30,48	30,48	60,00	30,48	30,48	30,48
No. of Lanes in Exit Pocket	0	0	0	0	0	0
Exit Pocket Length [m]	0,00	0,00	0,00	0,00	0,00	0,00
Speed [km/h]	48,28		60,00		60,00	
Grade [%]	0,00		0,00		0,00	
Curb Present	No		No		No	
Crosswalk	No		No		No	

Volumes

Name	Friedenheim St		D2296		D2296	
Base Volume Input [veh/h]	817	90	425	60	385	149
Base Volume Adjustment Factor	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000
Heavy Vehicles Percentage [%]	2,00	2,00	2,00	2,00	2,00	2,00
Growth Factor	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000
In-Process Volume [veh/h]	0	0	0	0	0	0
Site-Generated Trips [veh/h]	0	0	0	0	0	0
Diverted Trips [veh/h]	0	0	0	0	0	0
Pass-by Trips [veh/h]	0	0	0	0	0	0
Existing Site Adjustment Volume [veh/h]	0	0	0	0	0	0
Other Volume [veh/h]	0	0	0	0	0	0
Left-Turn on Red Volume [veh/h]	0	0	0	0	0	0
Total Hourly Volume [veh/h]	817	90	425	60	385	149
Peak Hour Factor	0,9500	0,9500	0,9500	0,9500	0,9500	0,9500
Other Adjustment Factor	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000
Total 15-Minute Volume [veh/h]	215	24	112	16	101	39
Total Analysis Volume [veh/h]	860	95	447	63	405	157
Presence of On-Street Parking	No	No	No	No	No	No
On-Street Parking Maneuver Rate [/h]	0	0	0	0	0	0
Local Bus Stopping Rate [/h]	0	0	0	0	0	0
v_do, Outbound Pedestrian Volume crossing	0		0		0	
v_di, Inbound Pedestrian Volume crossing m	0		0		0	
v_co, Outbound Pedestrian Volume crossing	0		0		0	
v_ci, Inbound Pedestrian Volume crossing mi	0		0		0	
v_ab, Corner Pedestrian Volume [ped/h]	0		0		0	
Bicycle Volume [bicycles/h]	0		0		0	

Intersection Settings

Located in CBD	No
Signal Coordination Group	-
Cycle Length [s]	150
Coordination Type	Time of Day Pattern Coordinated
Actuation Type	Fully actuated
Offset [s]	0,0
Offset Reference	Lead Green - Beginning of First Green
Permissive Mode	SingleBand
Lost time [s]	0,00

Phasing & Timing

Control Type	Permissive	Permissive	Permissive	Permissive	Permissive	Permissive
Signal Group	0	1	2	0	0	4
Auxiliary Signal Groups						
Lead / Lag	-	Lead	-	-	-	-
Minimum Green [s]	0	5	10	0	0	10
Maximum Green [s]	0	30	30	0	0	30
Amber [s]	0,0	3,0	3,0	0,0	0,0	3,0
All red [s]	0,0	1,0	1,0	0,0	0,0	1,0
Split [s]	0	82	26	0	0	42
Vehicle Extension [s]	0,0	3,0	3,0	0,0	0,0	3,0
Walk [s]	0	5	5	0	0	5
Pedestrian Clearance [s]	0	10	10	0	0	10
Delayed Vehicle Green [s]	0,0	0,0	0,0	0,0	0,0	0,0
Rest In Walk		No	No			No
I1, Start-Up Lost Time [s]	0,0	2,0	2,0	0,0	0,0	2,0
I2, Clearance Lost Time [s]	0,0	2,0	2,0	0,0	0,0	2,0
Minimum Recall		No	No			No
Maximum Recall		No	No			No
Pedestrian Recall		No	No			No
Detector Location [m]	0,0	0,0	0,0	0,0	0,0	0,0
Detector Length [m]	0,0	0,0	0,0	0,0	0,0	0,0
I, Upstream Filtering Factor	1,00	1,00	1,00	1,00	1,00	1,00

Exclusive Pedestrian Phase

Pedestrian Signal Group	0
Pedestrian Walk [s]	0
Pedestrian Clearance [s]	0

Lane Group Calculations

Lane Group	L	R	C	C	L	C
C, Cycle Length [s]	78	78	78	78	78	78
L, Total Lost Time per Cycle [s]	4,00	4,00	4,00	4,00	4,00	4,00
l1_p, Permitted Start-Up Lost Time [s]	0,00	0,00	0,00	0,00	0,00	0,00
l2, Clearance Lost Time [s]	2,00	2,00	2,00	2,00	2,00	2,00
g_i, Effective Green Time [s]	30	30	14	14	22	22
g / C, Green / Cycle	0,38	0,38	0,18	0,18	0,29	0,29
(v / s)_i Volume / Saturation Flow Rate	0,54	0,05	0,14	0,14	0,25	0,08
s, saturation flow rate [veh/h]	1589	1781	1702	1848	1589	1870
c, Capacity [veh/h]	609	682	303	329	454	534
d1, Uniform Delay [s]	24,18	15,76	30,89	30,90	26,82	21,82
k, delay calibration	0,50	0,11	0,11	0,11	0,21	0,11
I, Upstream Filtering Factor	1,00	1,00	1,00	1,00	1,00	1,00
d2, Incremental Delay [s]	195,51	0,09	5,00	4,68	10,95	0,30
d3, Initial Queue Delay [s]	0,00	0,00	0,00	0,00	0,00	0,00
Rp, platoon ratio	1,00	1,00	1,00	1,00	1,00	1,00
PF, progression factor	1,00	1,00	1,00	1,00	1,00	1,00

Lane Group Results

X, volume / capacity	1,41	0,14	0,80	0,81	0,89	0,29
d, Delay for Lane Group [s/veh]	219,69	15,85	35,89	35,58	37,77	22,12
Lane Group LOS	F	B	D	D	D	C
Critical Lane Group	Yes	No	No	Yes	Yes	No
50th-Percentile Queue Length [veh/ln]	43,42	1,07	4,60	4,98	8,08	2,16
50th-Percentile Queue Length [m/ln]	330,89	8,18	35,04	37,94	61,54	16,43
95th-Percentile Queue Length [veh/ln]	66,25	1,93	8,12	8,64	12,74	3,88
95th-Percentile Queue Length [m/ln]	504,85	14,72	61,84	65,82	97,05	29,58

Movement, Approach, & Intersection Results

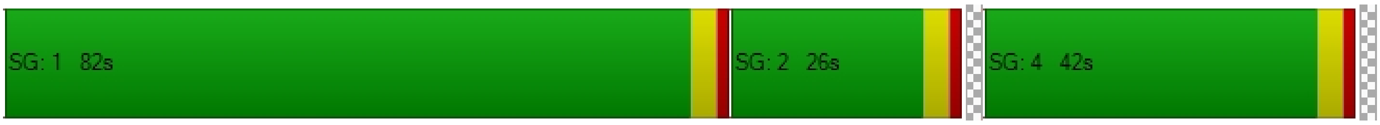
d_M, Delay for Movement [s/veh]	219,69	15,85	35,75	35,58	37,77	22,12
Movement LOS	F	B	D	D	D	C
d_A, Approach Delay [s/veh]	199,41		35,73		33,40	
Approach LOS	F		D		C	
d_I, Intersection Delay [s/veh]	112,20					
Intersection LOS	F					
Intersection V/C	0,940					

Other Modes

g_Walk,mi, Effective Walk Time [s]	0,0	0,0	0,0
M_corner, Corner Circulation Area [m²/ped]	0,00	0,00	0,00
M_CW, Crosswalk Circulation Area [m²/ped]	0,00	0,00	0,00
d_p, Pedestrian Delay [s]	0,00	0,00	0,00
I_p,int, Pedestrian LOS Score for Intersection	0,000	0,000	0,000
Crosswalk LOS	F	F	F
s_b, Saturation Flow Rate of the bicycle lane	2000	2000	2000
c_b, Capacity of the bicycle lane [bicycles/h]	1994	562	971
d_b, Bicycle Delay [s]	0,00	20,21	10,35
I_b,int, Bicycle LOS Score for Intersection	1,560	1,980	2,487
Bicycle LOS	A	A	B

Sequence

Ring 1	1	2	-	4	-	-	-	-	-	-	-	-	-	-	-	-
Ring 2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Ring 3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Ring 4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-



Intersection Level Of Service Report
Intersection 3: Kragbron Rd/ Timerhout St

Control Type:	All-way stop	Delay (sec / veh):	18,6
Analysis Method:	HCM 6th Edition	Level Of Service:	C
Analysis Period:	15 minutes	Volume to Capacity (v/c):	0,703

Intersection Setup

Name	Kragbron Rd			Kragbron Rd			Bester St.			Timerhout St		
Approach	Northbound			Southbound			Eastbound			Westbound		
Lane Configuration												
Turning Movement	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right
Lane Width [m]	3,70	3,70	3,70	3,70	3,70	3,70	3,70	3,70	3,70	3,70	3,70	3,70
No. of Lanes in Entry Pocket	0	0	0	1	0	0	1	0	0	0	0	0
Entry Pocket Length [m]	30,48	30,48	30,48	110,00	30,48	30,48	60,00	30,48	30,48	30,48	30,48	30,48
No. of Lanes in Exit Pocket	0	0	0	0	0	0	0	0	0	0	0	0
Exit Pocket Length [m]	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
Speed [km/h]	60,00			48,28			60,00			60,00		
Grade [%]	0,00			0,00			0,00			0,00		
Crosswalk	No			No			No			No		

Volumes

Name	Kragbron Rd			Kragbron Rd			Bester St.			Timerhout St		
Base Volume Input [veh/h]	137	219	8	10	201	188	281	14	54	7	1	8
Base Volume Adjustment Factor	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000
Heavy Vehicles Percentage [%]	2,00	2,00	2,00	2,00	2,00	2,00	2,00	2,00	2,00	2,00	2,00	2,00
Growth Factor	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000
In-Process Volume [veh/h]	0	0	0	0	0	0	0	0	0	0	0	0
Site-Generated Trips [veh/h]	0	0	0	0	0	0	0	0	0	0	0	0
Diverted Trips [veh/h]	0	0	0	0	0	0	0	0	0	0	0	0
Pass-by Trips [veh/h]	0	0	0	0	0	0	0	0	0	0	0	0
Existing Site Adjustment Volume [veh/h]	0	0	0	0	0	0	0	0	0	0	0	0
Other Volume [veh/h]	0	0	0	0	0	0	0	0	0	0	0	0
Total Hourly Volume [veh/h]	137	219	8	10	201	188	281	14	54	7	1	8
Peak Hour Factor	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000
Other Adjustment Factor	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000
Total 15-Minute Volume [veh/h]	34	55	2	3	50	47	70	4	14	2	0	2
Total Analysis Volume [veh/h]	137	219	8	10	201	188	281	14	54	7	1	8
Pedestrian Volume [ped/h]	0			0			0			0		

Intersection Settings

Lanes

Capacity per Entry Lane [veh/h]	582	649	554	586	496	471
Degree of Utilization, x	0,63	0,02	0,70	0,48	0,14	0,03

Movement, Approach, & Intersection Results

95th-Percentile Queue Length [veh]	4,32	0,05	5,58	2,59	0,47	0,11
95th-Percentile Queue Length [m]	32,95	0,36	42,56	19,72	3,60	0,80
Approach Delay [s/veh]	18,95	22,79		13,73		10,92
Approach LOS	C	C		B		B
Intersection Delay [s/veh]	18,58					
Intersection LOS	C					

Intersection Level Of Service Report
Intersection 6: Bester St/ Corrier St

Control Type:	Signalized	Delay (sec / veh):	53,4
Analysis Method:	HCM 6th Edition	Level Of Service:	D
Analysis Period:	15 minutes	Volume to Capacity (v/c):	0,526

Intersection Setup

Name	Currie St			Currie St.			Bester St.			Bester St.		
Approach	Northbound			Southbound			Eastbound			Westbound		
Lane Configuration												
Turning Movement	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right
Lane Width [m]	3,70	3,70	3,70	3,70	3,70	3,70	3,70	3,70	3,66	3,66	3,70	3,70
No. of Lanes in Entry Pocket	0	0	0	0	0	1	0	0	0	0	0	1
Entry Pocket Length [m]	30,48	30,48	30,48	30,48	30,48	10,00	30,48	30,48	30,48	30,48	30,48	30,48
No. of Lanes in Exit Pocket	0	0	0	0	0	0	0	0	0	0	0	0
Exit Pocket Length [m]	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
Speed [km/h]	60,00			60,00			60,00			60,00		
Grade [%]	0,00			0,00			0,00			0,00		
Curb Present	No			No			No			No		
Crosswalk	Yes			Yes			Yes			Yes		

Volumes

Name	Currie St			Currie St.			Bester St.			Bester St.		
Base Volume Input [veh/h]	109	19	70	156	0	71	53	294	0	0	527	44
Base Volume Adjustment Factor	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000
Heavy Vehicles Percentage [%]	2,00	2,00	2,00	2,00	2,00	2,00	2,00	2,00	2,00	2,00	2,00	2,00
Growth Factor	0,9500	0,9500	0,9500	0,9500	1,0000	0,9500	0,9500	0,9500	1,0000	1,0000	0,9500	0,9500
In-Process Volume [veh/h]	0	0	0	0	0	0	0	0	0	0	0	0
Site-Generated Trips [veh/h]	0	0	0	0	0	0	0	0	0	0	0	0
Diverted Trips [veh/h]	0	0	0	0	0	0	0	0	0	0	0	0
Pass-by Trips [veh/h]	0	0	0	0	0	0	0	0	0	0	0	0
Existing Site Adjustment Volume [veh/h]	0	0	0	0	0	0	0	0	0	0	0	0
Other Volume [veh/h]	0	0	0	0	0	0	0	0	0	0	0	0
Left-Turn on Red Volume [veh/h]	0	0	0	0	0	0	0	0	0	0	0	0
Total Hourly Volume [veh/h]	104	18	67	148	0	67	50	279	0	0	501	42
Peak Hour Factor	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000
Other Adjustment Factor	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000
Total 15-Minute Volume [veh/h]	26	5	17	37	0	17	13	70	0	0	125	11
Total Analysis Volume [veh/h]	104	18	67	148	0	67	50	279	0	0	501	42
Presence of On-Street Parking	No		No	No		No	No		No	No		No
On-Street Parking Maneuver Rate [/h]	0	0	0	0	0	0	0	0	0	0	0	0
Local Bus Stopping Rate [/h]	0	0	0	0	0	0	0	0	0	0	0	0
v_do, Outbound Pedestrian Volume crossing	0			0			0			0		
v_di, Inbound Pedestrian Volume crossing m	0			0			0			0		
v_co, Outbound Pedestrian Volume crossing	0			0			0			0		
v_ci, Inbound Pedestrian Volume crossing mi	0			0			0			0		
v_ab, Corner Pedestrian Volume [ped/h]	0			0			0			0		
Bicycle Volume [bicycles/h]	0			0			0			0		

Intersection Settings

Located in CBD	Yes
Signal Coordination Group	-
Cycle Length [s]	240
Coordination Type	Time of Day Pattern Coordinated
Actuation Type	Fixed time
Offset [s]	0,0
Offset Reference	Lead Green - Beginning of First Green
Permissive Mode	SingleBand
Lost time [s]	0,00

Phasing & Timing

Control Type	Permiss	Permiss	Permiss	Permiss	Permiss	Permiss	Permiss	Permiss	Permiss	Permiss	Permiss	Permiss
Signal Group	0	6	0	0	0	5	0	8	0	0	4	0
Auxiliary Signal Groups												
Lead / Lag	-	-	-	-	-	Lead	-	-	-	-	-	-
Minimum Green [s]	0	10	0	0	0	5	0	10	0	0	10	0
Maximum Green [s]	0	30	0	0	0	30	0	30	0	0	30	0
Amber [s]	0,0	3,0	0,0	0,0	0,0	3,0	0,0	3,0	0,0	0,0	3,0	0,0
All red [s]	0,0	1,0	0,0	0,0	0,0	1,0	0,0	1,0	0,0	0,0	1,0	0,0
Split [s]	0	58	0	0	0	49	0	133	0	0	133	0
Vehicle Extension [s]	0,0	3,0	0,0	0,0	0,0	3,0	0,0	3,0	0,0	0,0	3,0	0,0
Walk [s]	0	5	0	0	0	5	0	5	0	0	5	0
Pedestrian Clearance [s]	0	12	0	0	0	12	0	12	0	0	6	0
Delayed Vehicle Green [s]	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Rest In Walk		No				No		No			No	
I1, Start-Up Lost Time [s]	0,0	2,0	0,0	0,0	0,0	2,0	0,0	2,0	0,0	0,0	2,0	0,0
I2, Clearance Lost Time [s]	0,0	2,0	0,0	0,0	0,0	2,0	0,0	2,0	0,0	0,0	2,0	0,0
Minimum Recall		No				No		No			No	
Maximum Recall		No				No		No			No	
Pedestrian Recall		No				No		No			No	
Detector Location [m]	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Detector Length [m]	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
I, Upstream Filtering Factor	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00

Exclusive Pedestrian Phase

Pedestrian Signal Group	0
Pedestrian Walk [s]	0
Pedestrian Clearance [s]	0

Lane Group Calculations

Lane Group	C	L	R	L	C	C	R
C, Cycle Length [s]	240	240	240	240	240	240	240
L, Total Lost Time per Cycle [s]	4,00	4,00	4,00	4,00	4,00	4,00	4,00
l1_p, Permitted Start-Up Lost Time [s]	0,00	0,00	0,00	0,00	0,00	0,00	2,00
l2, Clearance Lost Time [s]	2,00	2,00	2,00	2,00	2,00	2,00	2,00
g_i, Effective Green Time [s]	54	45	45	129	129	129	129
g / C, Green / Cycle	0,23	0,19	0,19	0,54	0,54	0,54	0,54
(v / s)_i Volume / Saturation Flow Rate	0,13	0,10	0,04	0,03	0,17	0,30	0,04
s, saturation flow rate [veh/h]	1510	1431	1603	1431	1683	1683	990
c, Capacity [veh/h]	340	268	301	769	905	905	463
d1, Uniform Delay [s]	82,39	88,36	82,67	26,60	30,77	36,55	39,69
k, delay calibration	0,50	0,50	0,50	0,50	0,50	0,50	0,50
I, Upstream Filtering Factor	1,00	1,00	1,00	1,00	1,00	1,00	1,00
d2, Incremental Delay [s]	6,44	7,95	1,71	0,16	0,88	2,44	0,39
d3, Initial Queue Delay [s]	0,00	0,00	0,00	0,00	0,00	0,00	0,00
Rp, platoon ratio	1,00	1,00	1,00	1,00	1,00	1,00	1,00
PF, progression factor	1,00	1,00	1,00	1,00	1,00	1,00	1,00

Lane Group Results

X, volume / capacity	0,56	0,55	0,22	0,07	0,31	0,55	0,09
d, Delay for Lane Group [s/veh]	88,83	96,31	84,38	26,76	31,65	38,99	40,07
Lane Group LOS	F	F	F	C	C	D	D
Critical Lane Group	Yes	Yes	No	No	No	Yes	No
50th-Percentile Queue Length [veh/ln]	11,08	9,00	3,71	1,47	9,46	20,32	1,55
50th-Percentile Queue Length [m/ln]	84,40	68,61	28,24	11,17	72,08	154,80	11,84
95th-Percentile Queue Length [veh/ln]	16,53	13,92	6,67	2,64	14,50	27,71	2,80
95th-Percentile Queue Length [m/ln]	125,99	106,10	50,82	20,10	110,52	211,13	21,32

Movement, Approach, & Intersection Results

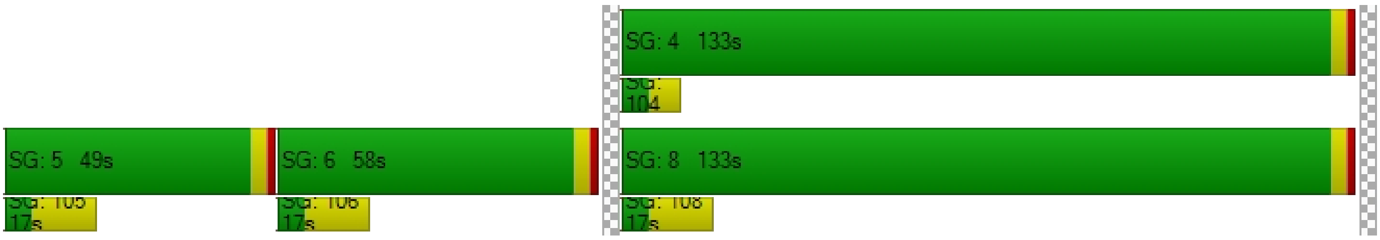
d_M, Delay for Movement [s/veh]	88,83	88,83	88,83	96,31	0,00	84,38	26,76	31,65	0,00	0,00	38,99	40,07
Movement LOS	F	F	F	F		F	C	C			D	D
d_A, Approach Delay [s/veh]	88,83			92,59			30,91			39,07		
Approach LOS	F			F			C			D		
d_I, Intersection Delay [s/veh]	53,36											
Intersection LOS	D											
Intersection V/C	0,526											

Other Modes

g_Walk,mi, Effective Walk Time [s]	9,0	9,0	9,0	9,0
M_corner, Corner Circulation Area [m²/ped]	0,00	0,00	0,00	0,00
M_CW, Crosswalk Circulation Area [m²/ped]	0,00	0,00	0,00	0,00
d_p, Pedestrian Delay [s]	111,17	111,17	111,17	111,17
I_p,int, Pedestrian LOS Score for Intersection	1,945	2,395	2,665	2,660
Crosswalk LOS	A	B	B	B
s_b, Saturation Flow Rate of the bicycle lane	2000	2000	2000	2000
c_b, Capacity of the bicycle lane [bicycles/h]	450	375	1075	1075
d_b, Bicycle Delay [s]	72,08	79,22	25,67	25,67
I_b,int, Bicycle LOS Score for Intersection	1,871	1,670	2,102	2,456
Bicycle LOS	A	A	B	B

Sequence

Ring 1	-	-	-	4	-	-	-	-	-	-	-	-	-	-	-	-
Ring 2	5	6	-	8	-	-	-	-	-	-	-	-	-	-	-	-
Ring 3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Ring 4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-



Intersection Level Of Service Report
Intersection 7: Bester St/ Henshall St.

Control Type:	Signalized	Delay (sec / veh):	47,0
Analysis Method:	HCM 6th Edition	Level Of Service:	D
Analysis Period:	15 minutes	Volume to Capacity (v/c):	0,541

Intersection Setup

Name	Henshall St.			Henshall St.			Bester St.			Bester St.		
Approach	Northbound			Southbound			Eastbound			Westbound		
Lane Configuration												
Turning Movement	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right
Lane Width [m]	3,70	3,70	3,70	3,70	3,70	3,70	3,66	3,66	3,66	3,70	3,70	3,70
No. of Lanes in Entry Pocket	0	0	0	0	0	0	0	0	0	0	0	0
Entry Pocket Length [m]	30,48	30,48	30,48	30,48	30,48	30,48	30,48	30,48	30,48	30,48	30,48	30,48
No. of Lanes in Exit Pocket	0	0	0	1	0	0	0	0	0	0	0	0
Exit Pocket Length [m]	0,00	0,00	0,00	15,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
Speed [km/h]	60,00			60,00			48,28			60,00		
Grade [%]	0,00			0,00			0,00			0,00		
Curb Present	No			No						No		
Crosswalk	Yes			Yes			Yes			Yes		

Volumes

Name	Henshall St.			Henshall St.			Bester St.			Bester St.		
Base Volume Input [veh/h]	150	279	167	246	403	120	0	0	0	150	265	239
Base Volume Adjustment Factor	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000
Heavy Vehicles Percentage [%]	2,00	2,00	2,00	2,00	2,00	2,00	2,00	2,00	2,00	2,00	2,00	2,00
Growth Factor	0,9500	0,9500	0,9500	0,9500	0,9500	0,9500	1,0000	1,0000	1,0000	0,9500	0,9500	0,9500
In-Process Volume [veh/h]	0	0	0	0	0	0	0	0	0	0	0	0
Site-Generated Trips [veh/h]	0	0	0	0	0	0	0	0	0	0	0	0
Diverted Trips [veh/h]	0	0	0	0	0	0	0	0	0	0	0	0
Pass-by Trips [veh/h]	0	0	0	0	0	0	0	0	0	0	0	0
Existing Site Adjustment Volume [veh/h]	0	0	0	0	0	0	0	0	0	0	0	0
Other Volume [veh/h]	0	0	0	0	0	0	0	0	0	0	0	0
Left-Turn on Red Volume [veh/h]	0	0	0	0	0	0	0	0	0	0	0	0
Total Hourly Volume [veh/h]	143	265	159	234	383	114	0	0	0	143	252	227
Peak Hour Factor	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000
Other Adjustment Factor	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000
Total 15-Minute Volume [veh/h]	36	66	40	59	96	29	0	0	0	36	63	57
Total Analysis Volume [veh/h]	143	265	159	234	383	114	0	0	0	143	252	227
Presence of On-Street Parking	No		No	No		No				No		No
On-Street Parking Maneuver Rate [/h]	0	0	0	0	0	0	0	0	0	0	0	0
Local Bus Stopping Rate [/h]	0	0	0	0	0	0	0	0	0	0	0	0
v_do, Outbound Pedestrian Volume crossing	0			0			0			0		
v_di, Inbound Pedestrian Volume crossing m	0			0			0			0		
v_co, Outbound Pedestrian Volume crossing	0			0			0			0		
v_ci, Inbound Pedestrian Volume crossing mi	0			0			0			0		
v_ab, Corner Pedestrian Volume [ped/h]	0			0			0			0		
Bicycle Volume [bicycles/h]	0			0			0			0		

Intersection Settings

Located in CBD	Yes
Signal Coordination Group	-
Cycle Length [s]	240
Coordination Type	Time of Day Pattern Coordinated
Actuation Type	Fixed time
Offset [s]	0,0
Offset Reference	Lead Green - Beginning of First Green
Permissive Mode	SingleBand
Lost time [s]	0,00

Phasing & Timing

Control Type	Permiss	Permiss	Permiss	Permiss	Permiss	Permiss	Permiss	Permiss	Permiss	Permiss	Permiss	Permiss
Signal Group	0	8	0	0	4	0	0	0	0	0	6	0
Auxiliary Signal Groups												
Lead / Lag	-	-	-	-	-	-	-	-	-	-	-	-
Minimum Green [s]	0	10	0	0	10	0	0	0	0	0	10	0
Maximum Green [s]	0	30	0	0	30	0	0	0	0	0	30	0
Amber [s]	0,0	3,0	0,0	0,0	3,0	0,0	0,0	0,0	0,0	0,0	3,0	0,0
All red [s]	0,0	1,0	0,0	0,0	1,0	0,0	0,0	0,0	0,0	0,0	1,0	0,0
Split [s]	0	144	0	0	144	0	0	0	0	0	96	0
Vehicle Extension [s]	0,0	3,0	0,0	0,0	3,0	0,0	0,0	0,0	0,0	0,0	3,0	0,0
Walk [s]	0	5	0	0	5	0	0	0	0	0	5	0
Pedestrian Clearance [s]	0	6	0	0	9	0	0	0	0	0	12	0
Delayed Vehicle Green [s]	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Rest In Walk		No			No						No	
I1, Start-Up Lost Time [s]	0,0	2,0	0,0	0,0	2,0	0,0	0,0	0,0	0,0	0,0	2,0	0,0
I2, Clearance Lost Time [s]	0,0	2,0	0,0	0,0	2,0	0,0	0,0	0,0	0,0	0,0	2,0	0,0
Minimum Recall		No			No						No	
Maximum Recall		No			No						No	
Pedestrian Recall		No			No						No	
Detector Location [m]	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Detector Length [m]	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
I, Upstream Filtering Factor	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00

Exclusive Pedestrian Phase

Pedestrian Signal Group	0
Pedestrian Walk [s]	0
Pedestrian Clearance [s]	0

Lane Group Calculations

Lane Group	C	C	C	C		C	C
C, Cycle Length [s]	240	240	240	240		240	240
L, Total Lost Time per Cycle [s]	4,00	4,00	4,00	4,00		4,00	4,00
l1_p, Permitted Start-Up Lost Time [s]	0,00	2,00	0,00	2,00		0,00	0,00
l2, Clearance Lost Time [s]	2,00	2,00	2,00	2,00		2,00	2,00
g_i, Effective Green Time [s]	140	140	140	140		92	92
g / C, Green / Cycle	0,58	0,58	0,58	0,58		0,38	0,38
(v / s)_i Volume / Saturation Flow Rate	0,28	0,34	0,31	0,32		0,21	0,20
s, saturation flow rate [veh/h]	1441	488	1399	918		1409	1627
c, Capacity [veh/h]	841	314	816	556		540	624
d1, Uniform Delay [s]	28,93	57,97	30,30	48,12		57,44	57,35
k, delay calibration	0,50	0,50	0,50	0,50		0,50	0,50
I, Upstream Filtering Factor	1,00	1,00	1,00	1,00		1,00	1,00
d2, Incremental Delay [s]	1,96	6,05	2,51	3,57		3,78	3,24
d3, Initial Queue Delay [s]	0,00	0,00	0,00	0,00		0,00	0,00
Rp, platoon ratio	1,00	1,00	1,00	1,00		1,00	1,00
PF, progression factor	1,00	1,00	1,00	1,00		1,00	1,00

Lane Group Results

X, volume / capacity	0,48	0,52	0,54	0,53		0,54	0,53
d, Delay for Lane Group [s/veh]	30,89	64,02	32,81	51,69		61,22	60,59
Lane Group LOS	C	E	C	D		E	E
Critical Lane Group	No	Yes	No	No		Yes	No
50th-Percentile Queue Length [veh/ln]	14,22	8,45	16,18	13,92		14,38	16,39
50th-Percentile Queue Length [m/ln]	108,38	64,38	123,30	106,09		109,58	124,93
95th-Percentile Queue Length [veh/ln]	20,41	13,22	22,78	20,04		20,60	23,03
95th-Percentile Queue Length [m/ln]	155,51	100,71	173,57	152,72		156,97	175,53

Movement, Approach, & Intersection Results

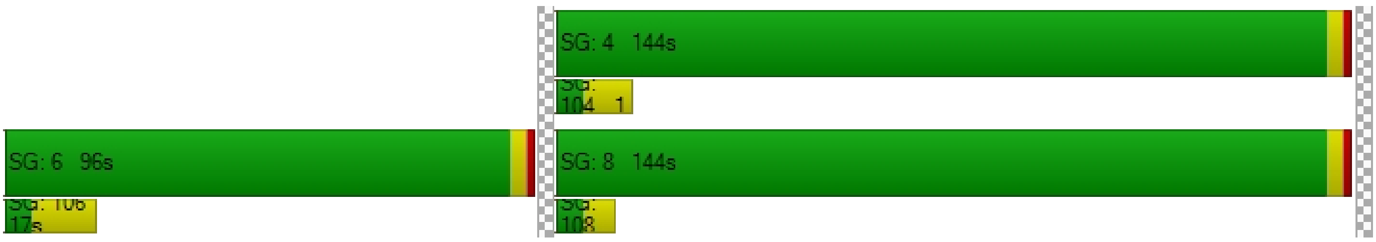
d_M, Delay for Movement [s/veh]	30,89	31,45	64,02	32,81	41,68	51,69	0,00	0,00	0,00	61,22	60,96	60,59
Movement LOS	C	C	E	C	D	D				E	E	E
d_A, Approach Delay [s/veh]		40,44			40,40			0,00			60,89	
Approach LOS		D			D			A			E	
d_I, Intersection Delay [s/veh]	47,05											
Intersection LOS	D											
Intersection V/C	0,541											

Other Modes

g_Walk,mi, Effective Walk Time [s]	9,0	9,0	9,0	9,0
M_corner, Corner Circulation Area [m²/ped]	0,00	0,00	0,00	0,00
M_CW, Crosswalk Circulation Area [m²/ped]	0,00	0,00	0,00	0,00
d_p, Pedestrian Delay [s]	111,17	111,17	111,17	111,17
I_p,int, Pedestrian LOS Score for Intersection	2,710	2,774	2,323	2,898
Crosswalk LOS	B	C	B	C
s_b, Saturation Flow Rate of the bicycle lane	2000	2000	2000	2000
c_b, Capacity of the bicycle lane [bicycles/h]	1167	1167	0	767
d_b, Bicycle Delay [s]	20,83	20,83	120,00	45,63
I_b,int, Bicycle LOS Score for Intersection	2,027	2,163	4,132	2,073
Bicycle LOS	B	B	D	B

Sequence

Ring 1	-	-	-	4	-	-	-	-	-	-	-	-	-	-	-	-
Ring 2	-	6	-	8	-	-	-	-	-	-	-	-	-	-	-	-
Ring 3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Ring 4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-



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Version 2021 (SP 0-6)

Intersection Level Of Service Report

Intersection 8: Samora Machel Dr/ Henshall St.

Control Type:	Signalized	Delay (sec / veh):	74,8
Analysis Method:	HCM 6th Edition	Level Of Service:	E
Analysis Period:	15 minutes	Volume to Capacity (v/c):	0,943

Intersection Setup

Name	Henshall St.			Henshall St.			Samore Machel Dr.			Samore Machel Dr.		
Approach	Northbound			Southbound			Eastbound			Westbound		
Lane Configuration												
Turning Movement	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right
Lane Width [m]	3,66	3,70	3,70	3,70	3,70	3,66	3,70	3,70	3,70	3,66	3,66	3,66
No. of Lanes in Entry Pocket	0	0	0	0	0	0	1	0	1	0	0	0
Entry Pocket Length [m]	30,48	30,48	30,48	30,48	30,48	30,48	100,00	30,48	100,00	30,48	30,48	30,48
No. of Lanes in Exit Pocket	0	0	0	0	0	0	0	0	0	0	0	0
Exit Pocket Length [m]	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
Speed [km/h]	48,28			60,00			60,00			48,28		
Grade [%]	0,00			0,00			0,00			0,00		
Curb Present	No			No			No					
Crosswalk	Yes			Yes			Yes			Yes		

Volumes

Name	Henshall St.			Henshall St.			Samore Machel Dr.			Samore Machel Dr.		
Base Volume Input [veh/h]	0	471	330	225	259	0	387	1121	275	0	0	0
Base Volume Adjustment Factor	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000
Heavy Vehicles Percentage [%]	2,00	2,00	2,00	2,00	2,00	2,00	2,00	2,00	2,00	2,00	2,00	2,00
Growth Factor	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000
In-Process Volume [veh/h]	0	0	0	0	0	0	0	0	0	0	0	0
Site-Generated Trips [veh/h]	0	0	0	0	0	0	0	0	0	0	0	0
Diverted Trips [veh/h]	0	0	0	0	0	0	0	0	0	0	0	0
Pass-by Trips [veh/h]	0	0	0	0	0	0	0	0	0	0	0	0
Existing Site Adjustment Volume [veh/h]	0	0	0	0	0	0	0	0	0	0	0	0
Other Volume [veh/h]	0	0	0	0	0	0	0	0	0	0	0	0
Left-Turn on Red Volume [veh/h]	0	0	0	0	0	0	0	0	0	0	0	0
Total Hourly Volume [veh/h]	0	471	330	225	259	0	387	1121	275	0	0	0
Peak Hour Factor	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000
Other Adjustment Factor	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000
Total 15-Minute Volume [veh/h]	0	118	83	56	65	0	97	280	69	0	0	0
Total Analysis Volume [veh/h]	0	471	330	225	259	0	387	1121	275	0	0	0
Presence of On-Street Parking	No		No	No		No	No		No			
On-Street Parking Maneuver Rate [/h]	0	0	0	0	0	0	0	0	0	0	0	0
Local Bus Stopping Rate [/h]	0	0	0	0	0	0	0	0	0	0	0	0
v_do, Outbound Pedestrian Volume crossing	0			0			0			0		
v_di, Inbound Pedestrian Volume crossing m	0			0			0			0		
v_co, Outbound Pedestrian Volume crossing	0			0			0			0		
v_ci, Inbound Pedestrian Volume crossing mi	0			0			0			0		
v_ab, Corner Pedestrian Volume [ped/h]	0			0			0			0		
Bicycle Volume [bicycles/h]	0			0			0			0		

Intersection Settings

Located in CBD	Yes
Signal Coordination Group	-
Cycle Length [s]	240
Coordination Type	Time of Day Pattern Coordinated
Actuation Type	Fixed time
Offset [s]	0,0
Offset Reference	Lead Green - Beginning of First Green
Permissive Mode	SingleBand
Lost time [s]	0,00

Phasing & Timing

Control Type	Permiss	Permiss	Permiss	Permiss	Permiss	Permiss	Permiss	Permiss	Permiss	Permiss	Permiss	Permiss
Signal Group	0	6	0	0	2	0	0	8	0	0	0	0
Auxiliary Signal Groups												
Lead / Lag	-	-	-	-	-	-	-	-	-	-	-	-
Minimum Green [s]	0	10	0	0	10	0	0	10	0	0	0	0
Maximum Green [s]	0	30	0	0	30	0	0	30	0	0	0	0
Amber [s]	0,0	3,0	0,0	0,0	3,0	0,0	0,0	3,0	0,0	0,0	0,0	0,0
All red [s]	0,0	1,0	0,0	0,0	1,0	0,0	0,0	1,0	0,0	0,0	0,0	0,0
Split [s]	0	168	0	0	168	0	0	72	0	0	0	0
Vehicle Extension [s]	0,0	3,0	0,0	0,0	3,0	0,0	0,0	3,0	0,0	0,0	0,0	0,0
Walk [s]	0	5	0	0	5	0	0	5	0	0	0	0
Pedestrian Clearance [s]	0	22	0	0	12	0	0	12	0	0	0	0
Delayed Vehicle Green [s]	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Rest In Walk		No			No			No				
I1, Start-Up Lost Time [s]	0,0	2,0	0,0	0,0	2,0	0,0	0,0	2,0	0,0	0,0	0,0	0,0
I2, Clearance Lost Time [s]	0,0	2,0	0,0	0,0	2,0	0,0	0,0	2,0	0,0	0,0	0,0	0,0
Minimum Recall		No			No			No				
Maximum Recall		No			No			No				
Pedestrian Recall		No			No			No				
Detector Location [m]	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Detector Length [m]	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
I, Upstream Filtering Factor	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00

Exclusive Pedestrian Phase

Pedestrian Signal Group	0
Pedestrian Walk [s]	0
Pedestrian Clearance [s]	0

Lane Group Calculations

Lane Group	C	L	C	L	C	R	
C, Cycle Length [s]	240	240	240	240	240	240	
L, Total Lost Time per Cycle [s]	4,00	4,00	4,00	4,00	4,00	4,00	
l1_p, Permitted Start-Up Lost Time [s]	2,00	0,00	0,00	0,00	0,00	0,00	
l2, Clearance Lost Time [s]	2,00	2,00	2,00	2,00	2,00	2,00	
g_i, Effective Green Time [s]	164	164	164	68	68	68	
g / C, Green / Cycle	0,68	0,68	0,68	0,28	0,28	0,28	
(v / s)_i Volume / Saturation Flow Rate	0,67	0,16	0,15	0,27	0,24	0,17	
s, saturation flow rate [veh/h]	1192	1431	1683	1431	4584	1603	
c, Capacity [veh/h]	836	978	1150	405	1299	454	
d1, Uniform Delay [s]	44,72	14,28	14,22	84,49	81,58	74,40	
k, delay calibration	0,50	0,50	0,50	0,50	0,50	0,50	
I, Upstream Filtering Factor	1,00	1,00	1,00	1,00	1,00	1,00	
d2, Incremental Delay [s]	22,54	0,55	0,45	34,68	7,76	5,89	
d3, Initial Queue Delay [s]	0,00	0,00	0,00	0,00	0,00	0,00	
Rp, platoon ratio	1,00	1,00	1,00	1,00	1,00	1,00	
PF, progression factor	1,00	1,00	1,00	1,00	1,00	1,00	

Lane Group Results

X, volume / capacity	0,96	0,23	0,23	0,95	0,86	0,61	
d, Delay for Lane Group [s/veh]	67,26	14,83	14,68	119,17	89,34	80,29	
Lane Group LOS	E	B	B	F	F	F	
Critical Lane Group	Yes	No	No	Yes	No	No	
50th-Percentile Queue Length [veh/ln]	51,36	4,93	5,62	27,55	22,97	15,54	
50th-Percentile Queue Length [m/ln]	391,37	37,55	42,85	209,90	175,06	118,38	
95th-Percentile Queue Length [veh/ln]	63,11	8,57	9,51	36,15	30,84	22,00	
95th-Percentile Queue Length [m/ln]	480,92	65,29	72,49	275,49	234,96	167,64	

Movement, Approach, & Intersection Results

d_M, Delay for Movement [s/veh]	0,00	67,26	67,26	14,83	14,68	0,00	119,17	89,34	80,29	0,00	0,00	0,00
Movement LOS		E	E	B	B		F	F	F			
d_A, Approach Delay [s/veh]	67,26			14,75			94,42			0,00		
Approach LOS	E			B			F			A		
d_I, Intersection Delay [s/veh]	74,76											
Intersection LOS	E											
Intersection V/C	0,943											

Other Modes

g_Walk,mi, Effective Walk Time [s]	9,0	9,0	9,0	9,0
M_corner, Corner Circulation Area [m²/ped]	0,00	0,00	0,00	0,00
M_CW, Crosswalk Circulation Area [m²/ped]	0,00	0,00	0,00	0,00
d_p, Pedestrian Delay [s]	111,17	111,17	111,17	111,17
I_p,int, Pedestrian LOS Score for Intersection	2,685	2,832	3,137	3,304
Crosswalk LOS	B	C	C	C
s_b, Saturation Flow Rate of the bicycle lane	2000	2000	2000	2000
c_b, Capacity of the bicycle lane [bicycles/h]	1367	1367	567	0
d_b, Bicycle Delay [s]	12,03	12,03	61,63	120,00
I_b,int, Bicycle LOS Score for Intersection	2,881	2,358	2,540	4,132
Bicycle LOS	C	B	B	D

Sequence

Ring 1	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Ring 2	-	6	-	8	-	-	-	-	-	-	-	-	-	-	-	-
Ring 3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Ring 4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Intersection Level Of Service Report
Intersection 9: Bell St./Henshall St.

Control Type:	Signalized	Delay (sec / veh):	256,4
Analysis Method:	HCM 6th Edition	Level Of Service:	F
Analysis Period:	15 minutes	Volume to Capacity (v/c):	1,458

Intersection Setup

Name	Henshall St.			Henshall St.			Bell St.			Bell St.		
Approach	Northbound			Southbound			Eastbound			Westbound		
Lane Configuration												
Turning Movement	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right
Lane Width [m]	3,70	3,70	3,66	3,66	3,70	3,70	3,66	3,66	3,66	3,70	3,70	3,70
No. of Lanes in Entry Pocket	0	0	0	0	0	0	0	0	0	0	0	1
Entry Pocket Length [m]	30,48	30,48	30,48	30,48	30,48	30,48	30,48	30,48	30,48	30,48	30,48	30,48
No. of Lanes in Exit Pocket	0	0	0	0	0	0	0	0	0	0	0	0
Exit Pocket Length [m]	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
Speed [km/h]	60,00			60,00			48,28			60,00		
Grade [%]	0,00			0,00			0,00			0,00		
Curb Present	No			No						No		
Crosswalk	Yes			Yes			Yes			Yes		

Volumes

Name	Henshall St.			Henshall St.			Bell St.			Bell St.		
Base Volume Input [veh/h]	271	925	0	0	421	254	0	0	0	291	1780	563
Base Volume Adjustment Factor	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000
Heavy Vehicles Percentage [%]	2,00	2,00	2,00	2,00	2,00	2,00	2,00	2,00	2,00	2,00	2,00	2,00
Growth Factor	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000
In-Process Volume [veh/h]	0	0	0	0	0	0	0	0	0	0	0	0
Site-Generated Trips [veh/h]	0	0	0	0	0	0	0	0	0	0	0	0
Diverted Trips [veh/h]	0	0	0	0	0	0	0	0	0	0	0	0
Pass-by Trips [veh/h]	0	0	0	0	0	0	0	0	0	0	0	0
Existing Site Adjustment Volume [veh/h]	0	0	0	0	0	0	0	0	0	0	0	0
Other Volume [veh/h]	0	0	0	0	0	0	0	0	0	0	0	0
Left-Turn on Red Volume [veh/h]	0	0	0	0	0	0	0	0	0	0	0	0
Total Hourly Volume [veh/h]	271	925	0	0	421	254	0	0	0	291	1780	563
Peak Hour Factor	0,9500	0,9500	1,0000	1,0000	0,9500	0,9500	1,0000	1,0000	1,0000	0,9500	0,9500	0,9500
Other Adjustment Factor	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000
Total 15-Minute Volume [veh/h]	71	243	0	0	111	67	0	0	0	77	468	148
Total Analysis Volume [veh/h]	285	974	0	0	443	267	0	0	0	306	1874	593
Presence of On-Street Parking	No		No	No		No				No		No
On-Street Parking Maneuver Rate [/h]	0	0	0	0	0	0	0	0	0	0	0	0
Local Bus Stopping Rate [/h]	0	0	0	0	0	0	0	0	0	0	0	0
v_do, Outbound Pedestrian Volume crossing	0			0			0			0		
v_di, Inbound Pedestrian Volume crossing m	0			0			0			0		
v_co, Outbound Pedestrian Volume crossing	0			0			0			0		
v_ci, Inbound Pedestrian Volume crossing mi	0			0			0			0		
v_ab, Corner Pedestrian Volume [ped/h]	0			0			0			0		
Bicycle Volume [bicycles/h]	0			0			0			0		

Intersection Settings

Located in CBD	Yes
Signal Coordination Group	-
Cycle Length [s]	60
Coordination Type	Time of Day Pattern Coordinated
Actuation Type	Fixed time
Offset [s]	0,0
Offset Reference	Lead Green - Beginning of First Green
Permissive Mode	SingleBand
Lost time [s]	0,00

Phasing & Timing

Control Type	Permiss	Permiss	Permiss	Permiss	Permiss	Permiss	Permiss	Permiss	Permiss	Permiss	Permiss	Permiss
Signal Group	0	6	0	0	2	0	0	0	0	0	4	0
Auxiliary Signal Groups												
Lead / Lag	-	-	-	-	-	-	-	-	-	-	-	-
Minimum Green [s]	0	10	0	0	10	0	0	0	0	0	10	0
Maximum Green [s]	0	30	0	0	30	0	0	0	0	0	30	0
Amber [s]	0,0	3,0	0,0	0,0	3,0	0,0	0,0	0,0	0,0	0,0	3,0	0,0
All red [s]	0,0	1,0	0,0	0,0	1,0	0,0	0,0	0,0	0,0	0,0	1,0	0,0
Split [s]	0	27	0	0	27	0	0	0	0	0	33	0
Vehicle Extension [s]	0,0	3,0	0,0	0,0	3,0	0,0	0,0	0,0	0,0	0,0	3,0	0,0
Walk [s]	0	5	0	0	5	0	0	0	0	0	5	0
Pedestrian Clearance [s]	0	6	0	0	12	0	0	0	0	0	9	0
Delayed Vehicle Green [s]	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Rest In Walk		No			No						No	
I1, Start-Up Lost Time [s]	0,0	2,0	0,0	0,0	2,0	0,0	0,0	0,0	0,0	0,0	2,0	0,0
I2, Clearance Lost Time [s]	0,0	2,0	0,0	0,0	2,0	0,0	0,0	0,0	0,0	0,0	2,0	0,0
Minimum Recall		No			No						No	
Maximum Recall		No			No						No	
Pedestrian Recall		No			No						No	
Detector Location [m]	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Detector Length [m]	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
I, Upstream Filtering Factor	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00

Exclusive Pedestrian Phase

Pedestrian Signal Group	0
Pedestrian Walk [s]	0
Pedestrian Clearance [s]	0

Lane Group Calculations

Lane Group	C	C	C		C	C	R
C, Cycle Length [s]	60	60	60		60	60	60
L, Total Lost Time per Cycle [s]	4,00	4,00	4,00		4,00	4,00	4,00
l1_p, Permitted Start-Up Lost Time [s]	0,00	0,00	2,00		0,00	0,00	0,00
l2, Clearance Lost Time [s]	2,00	2,00	2,00		2,00	2,00	2,00
g_i, Effective Green Time [s]	23	23	23		29	29	29
g / C, Green / Cycle	0,38	0,38	0,38		0,48	0,48	0,48
(v / s)_i Volume / Saturation Flow Rate	0,78	0,29	10000,00		0,68	0,65	0,37
s, saturation flow rate [veh/h]	1618	1532	0		1604	1683	1603
c, Capacity [veh/h]	620	587	120		775	813	775
d1, Uniform Delay [s]	18,50	16,05	30,00		15,50	15,50	12,71
k, delay calibration	0,50	0,50	0,50		0,50	0,50	0,50
I, Upstream Filtering Factor	1,00	1,00	1,00		1,00	1,00	1,00
d2, Incremental Delay [s]	468,91	8,74	577,27		190,58	161,27	7,10
d3, Initial Queue Delay [s]	0,00	0,00	0,00		0,00	0,00	0,00
Rp, platoon ratio	1,00	1,00	1,00		1,00	1,00	1,00
PF, progression factor	1,00	1,00	1,00		1,00	1,00	1,00

Lane Group Results

X, volume / capacity	2,03	0,75	2,23		1,41	1,34	0,77
d, Delay for Lane Group [s/veh]	487,41	24,79	607,27		206,08	176,77	19,82
Lane Group LOS	F	C	F		F	F	B
Critical Lane Group	Yes	No	No		Yes	No	No
50th-Percentile Queue Length [veh/ln]	87,91	5,83	20,86		49,13	44,94	6,61
50th-Percentile Queue Length [m/ln]	669,87	44,40	158,93		374,34	342,41	50,36
95th-Percentile Queue Length [veh/ln]	141,05	9,79	37,54		75,15	67,71	10,82
95th-Percentile Queue Length [m/ln]	1074,78	74,57	286,07		572,62	515,98	82,48

Movement, Approach, & Intersection Results

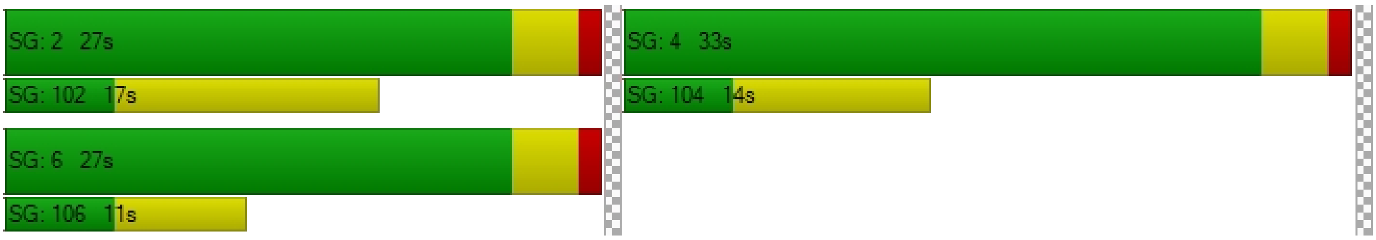
d_M, Delay for Movement [s/veh]	487,41	487,41	0,00	0,00	24,79	607,27	0,00	0,00	0,00	206,08	189,03	19,82
Movement LOS	F	F			C	F				F	F	B
d_A, Approach Delay [s/veh]	487,41			243,83			0,00			154,73		
Approach LOS	F			F			A			F		
d_I, Intersection Delay [s/veh]	256,39											
Intersection LOS	F											
Intersection V/C	1,458											

Other Modes

g_Walk,mi, Effective Walk Time [s]	9,0	9,0	9,0	9,0
M_corner, Corner Circulation Area [m²/ped]	0,00	0,00	0,00	0,00
M_CW, Crosswalk Circulation Area [m²/ped]	0,00	0,00	0,00	0,00
d_p, Pedestrian Delay [s]	21,68	21,68	21,68	21,68
I_p,int, Pedestrian LOS Score for Intersection	3,226	3,401	3,979	3,464
Crosswalk LOS	C	C	D	C
s_b, Saturation Flow Rate of the bicycle lane	2000	2000	2000	2000
c_b, Capacity of the bicycle lane [bicycles/h]	767	767	0	967
d_b, Bicycle Delay [s]	11,41	11,41	30,00	8,01
I_b,int, Bicycle LOS Score for Intersection	3,637	2,145	4,132	3,847
Bicycle LOS	D	B	D	D

Sequence

Ring 1	-	2	-	4	-	-	-	-	-	-	-	-	-	-	-	-
Ring 2	-	6	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Ring 3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Ring 4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-



Intersection Level Of Service Report
Intersection 10: Andrew St/ Henshall St

Control Type:	All-way stop	Delay (sec / veh):	9,8
Analysis Method:	HCM 6th Edition	Level Of Service:	A
Analysis Period:	15 minutes	Volume to Capacity (v/c):	0,342

Intersection Setup

Name	Henshall St.		Andrew St.		Andrew St.	
Approach	Northbound		Eastbound		Westbound	
Lane Configuration						
Turning Movement	Left	Right	Thru	Right	Left	Thru
Lane Width [m]	3,70	3,70	3,70	3,70	3,70	3,70
No. of Lanes in Entry Pocket	0	0	0	1	0	0
Entry Pocket Length [m]	30,48	30,48	30,48	300,00	30,48	30,48
No. of Lanes in Exit Pocket	0	0	0	0	0	0
Exit Pocket Length [m]	0,00	0,00	0,00	0,00	0,00	0,00
Speed [km/h]	60,00		60,00		60,00	
Grade [%]	0,00		0,00		0,00	
Crosswalk	Yes		Yes		Yes	

Volumes

Name	Henshall St.		Andrew St.		Andrew St.	
Base Volume Input [veh/h]	193	46	117	217	1	48
Base Volume Adjustment Factor	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000
Heavy Vehicles Percentage [%]	2,00	2,00	2,00	2,00	2,00	2,00
Growth Factor	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000
In-Process Volume [veh/h]	0	0	0	0	0	0
Site-Generated Trips [veh/h]	0	0	0	0	0	0
Diverted Trips [veh/h]	0	0	0	0	0	0
Pass-by Trips [veh/h]	0	0	0	0	0	0
Existing Site Adjustment Volume [veh/h]	0	0	0	0	0	0
Other Volume [veh/h]	0	0	0	0	0	0
Total Hourly Volume [veh/h]	193	46	117	217	1	48
Peak Hour Factor	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000
Other Adjustment Factor	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000
Total 15-Minute Volume [veh/h]	48	12	29	54	0	12
Total Analysis Volume [veh/h]	193	46	117	217	1	48
Pedestrian Volume [ped/h]	0		0		0	

Intersection Settings

Lanes

Capacity per Entry Lane [veh/h]	812	697	636	716
Degree of Utilization, x	0,29	0,17	0,34	0,07

Movement, Approach, & Intersection Results

95th-Percentile Queue Length [veh]	1,23	0,60	1,51	0,22
95th-Percentile Queue Length [m]	9,37	4,57	11,52	1,67
Approach Delay [s/veh]	9,27	10,44		8,40
Approach LOS	A	B		A
Intersection Delay [s/veh]	9,83			
Intersection LOS	A			

Intersection Level Of Service Report
Intersection 11: Old Pretoria Rd/ Madiba Dr

Control Type:	Signalized	Delay (sec / veh):	378,4
Analysis Method:	HCM 6th Edition	Level Of Service:	F
Analysis Period:	15 minutes	Volume to Capacity (v/c):	3,684

Intersection Setup

Name	Madiba Dr.			Madiba Dr.			Old Pretoria Rd			Old Pretoria Rd		
Approach	Northbound			Southbound			Eastbound			Westbound		
Lane Configuration												
Turning Movement	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right
Lane Width [m]	3,70	3,70	3,70	3,70	3,70	3,70	3,70	3,70	3,70	3,70	3,70	3,70
No. of Lanes in Entry Pocket	1	0	1	1	0	1	1	0	1	1	0	1
Entry Pocket Length [m]	50,00	30,48	90,00	100,00	30,48	60,00	50,00	30,48	60,00	60,00	30,48	100,00
No. of Lanes in Exit Pocket	0	0	0	0	0	0	0	0	0	0	0	0
Exit Pocket Length [m]	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
Speed [km/h]	60,00			60,00			60,00			60,00		
Grade [%]	0,00			0,00			0,00			0,00		
Curb Present	No			No			No			No		
Crosswalk	Yes			Yes			Yes			Yes		

Volumes

Name	Madiba Dr.			Madiba Dr.			Old Pretoria Rd			Old Pretoria Rd		
Base Volume Input [veh/h]	467	2300	132	884	2167	629	886	1313	282	113	386	661
Base Volume Adjustment Factor	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000
Heavy Vehicles Percentage [%]	2,00	2,00	2,00	2,00	2,00	2,00	2,00	2,00	2,00	2,00	2,00	2,00
Growth Factor	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000
In-Process Volume [veh/h]	0	0	0	0	0	0	0	0	0	0	0	0
Site-Generated Trips [veh/h]	0	0	0	0	0	0	0	0	0	0	0	0
Diverted Trips [veh/h]	0	0	0	0	0	0	0	0	0	0	0	0
Pass-by Trips [veh/h]	0	0	0	0	0	0	0	0	0	0	0	0
Existing Site Adjustment Volume [veh/h]	0	0	0	0	0	0	0	0	0	0	0	0
Other Volume [veh/h]	0	0	0	0	0	0	0	0	0	0	0	0
Left-Turn on Red Volume [veh/h]	0	0	0	0	0	0	0	0	0	0	0	0
Total Hourly Volume [veh/h]	467	2300	132	884	2167	629	886	1313	282	113	386	661
Peak Hour Factor	0,9500	0,9500	0,9500	0,9500	0,9500	0,9500	0,9500	0,9500	0,9500	0,9500	0,9500	0,9500
Other Adjustment Factor	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000
Total 15-Minute Volume [veh/h]	123	605	35	233	570	166	233	346	74	30	102	174
Total Analysis Volume [veh/h]	492	2421	139	931	2281	662	933	1382	297	119	406	696
Presence of On-Street Parking	No		No	No		No	No		No	No		No
On-Street Parking Maneuver Rate [/h]	0	0	0	0	0	0	0	0	0	0	0	0
Local Bus Stopping Rate [/h]	0	0	0	0	0	0	0	0	0	0	0	0
v_do, Outbound Pedestrian Volume crossing	0			0			0			0		
v_di, Inbound Pedestrian Volume crossing m	0			0			0			0		
v_co, Outbound Pedestrian Volume crossing	0			0			0			0		
v_ci, Inbound Pedestrian Volume crossing mi	0			0			0			0		
v_ab, Corner Pedestrian Volume [ped/h]	0			0			0			0		
Bicycle Volume [bicycles/h]	0			0			0			0		

Generated with PTV VISTRO
Version 2021 (SP 0-6)

Intersection Settings

Located in CBD	Yes
Signal Coordination Group	-
Cycle Length [s]	70
Coordination Type	Time of Day Pattern Coordinated
Actuation Type	Fixed time
Offset [s]	0,0
Offset Reference	Lead Green - Beginning of First Green
Permissive Mode	SingleBand
Lost time [s]	0,00

Phasing & Timing

Control Type	Permiss	Permiss	Permiss	Permiss	Permiss	Permiss	Permiss	Permiss	Permiss	Permiss	Permiss	Permiss
Signal Group	0	6	0	0	2	0	0	8	0	0	4	0
Auxiliary Signal Groups												
Lead / Lag	-	-	-	-	-	-	-	-	-	-	-	-
Minimum Green [s]	0	10	0	0	10	0	0	10	0	0	10	0
Maximum Green [s]	0	30	0	0	30	0	0	30	0	0	30	0
Amber [s]	0,0	3,0	0,0	0,0	3,0	0,0	0,0	3,0	0,0	0,0	3,0	0,0
All red [s]	0,0	1,0	0,0	0,0	1,0	0,0	0,0	1,0	0,0	0,0	1,0	0,0
Split [s]	0	31	0	0	31	0	0	39	0	0	39	0
Vehicle Extension [s]	0,0	3,0	0,0	0,0	3,0	0,0	0,0	3,0	0,0	0,0	3,0	0,0
Walk [s]	0	5	0	0	5	0	0	5	0	0	5	0
Pedestrian Clearance [s]	0	22	0	0	22	0	0	30	0	0	27	0
Delayed Vehicle Green [s]	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Rest In Walk		No			No			No			No	
I1, Start-Up Lost Time [s]	0,0	2,0	0,0	0,0	2,0	0,0	0,0	2,0	0,0	0,0	2,0	0,0
I2, Clearance Lost Time [s]	0,0	2,0	0,0	0,0	2,0	0,0	0,0	2,0	0,0	0,0	2,0	0,0
Minimum Recall		No			No			No			No	
Maximum Recall		No			No			No			No	
Pedestrian Recall		No			No			No			No	
Detector Location [m]	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Detector Length [m]	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
I, Upstream Filtering Factor	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00

Exclusive Pedestrian Phase

Pedestrian Signal Group	0
Pedestrian Walk [s]	0
Pedestrian Clearance [s]	0

Lane Group Calculations

Lane Group	L	C	R	L	C	R	L	C	R	L	C	R
C, Cycle Length [s]	70	70	70	70	70	70	70	70	70	70	70	70
L, Total Lost Time per Cycle [s]	4,00	4,00	4,00	4,00	4,00	4,00	4,00	4,00	4,00	4,00	4,00	4,00
l1_p, Permitted Start-Up Lost Time [s]	0,00	0,00	2,00	0,00	0,00	2,00	0,00	0,00	2,00	0,00	0,00	2,00
l2, Clearance Lost Time [s]	2,00	2,00	2,00	2,00	2,00	2,00	2,00	2,00	2,00	2,00	2,00	2,00
g_i, Effective Green Time [s]	27	27	27	27	27	27	35	35	35	35	35	35
g / C, Green / Cycle	0,39	0,39	0,39	0,39	0,39	0,39	0,50	0,50	0,50	0,50	0,50	0,50
(v / s)_i Volume / Saturation Flow Rate	0,34	0,53	0,95	0,65	0,50	2,67	0,65	0,43	0,17	0,08	0,13	1,02
s, saturation flow rate [veh/h]	1431	4584	147	1431	4584	248	1431	3204	1711	1431	3204	685
c, Capacity [veh/h]	552	1768	103	552	1768	103	715	1602	785	715	1602	166
d1, Uniform Delay [s]	20,13	21,50	35,00	21,50	21,50	35,00	17,50	15,39	15,30	9,54	10,02	33,77
k, delay calibration	0,50	0,50	0,50	0,50	0,50	0,50	0,50	0,50	0,50	0,50	0,50	0,50
I, Upstream Filtering Factor	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00
d2, Incremental Delay [s]	19,25	169,80	209,04	317,08	134,86	2466,80	147,03	6,39	1,39	0,50	0,38	1450,46
d3, Initial Queue Delay [s]	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
Rp, platoon ratio	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00
PF, progression factor	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00

Lane Group Results

X, volume / capacity	0,89	1,37	1,35	1,69	1,29	6,44	1,30	0,86	0,38	0,17	0,25	4,19
d, Delay for Lane Group [s/veh]	39,38	191,30	244,04	338,58	156,36	2501,80	164,53	21,78	16,69	10,05	10,40	1484,23
Lane Group LOS	D	F	F	F	F	F	F	C	B	B	B	F
Critical Lane Group	No	No	No	No	No	Yes	No	No	No	No	No	Yes
50th-Percentile Queue Length [veh/ln]	9,50	36,18	7,64	56,44	30,46	36,07	38,52	9,33	1,67	0,94	1,60	34,80
50th-Percentile Queue Length [m/ln]	72,37	275,68	58,23	430,09	232,09	274,89	293,54	71,09	12,76	7,20	12,17	265,14
95th-Percentile Queue Length [veh/ln]	14,55	55,36	13,76	89,57	46,12	63,72	58,14	14,34	3,01	1,70	2,88	62,63
95th-Percentile Queue Length [m/ln]	110,88	421,85	104,82	682,49	351,44	485,57	443,05	109,26	22,96	12,95	21,91	477,25

Movement, Approach, & Intersection Results

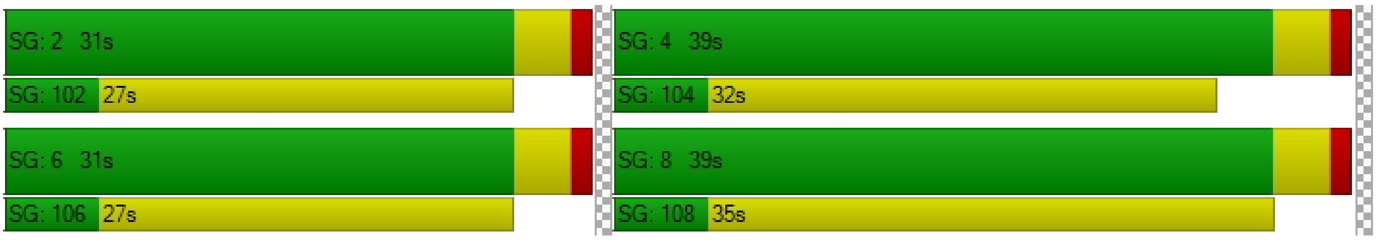
d_M, Delay for Movement [s/veh]	39,38	191,30	244,04	338,58	156,36	2501,80	164,53	21,78	16,69	10,05	10,40	1484,23
Movement LOS	D	F	F	F	F	F	F	C	B	B	B	F
d_A, Approach Delay [s/veh]	169,21			600,95			72,19			850,49		
Approach LOS	F			F			E			F		
d_I, Intersection Delay [s/veh]	378,43											
Intersection LOS	F											
Intersection V/C	3,684											

Other Modes

g_Walk,mi, Effective Walk Time [s]	9,0	9,0	9,0	9,0
M_corner, Corner Circulation Area [m²/ped]	0,00	0,00	0,00	0,00
M_CW, Crosswalk Circulation Area [m²/ped]	0,00	0,00	0,00	0,00
d_p, Pedestrian Delay [s]	26,58	26,58	26,58	26,58
I_p,int, Pedestrian LOS Score for Intersection	4,538	5,545	4,687	3,804
Crosswalk LOS	E	F	E	D
s_b, Saturation Flow Rate of the bicycle lane	2000	2000	2000	2000
c_b, Capacity of the bicycle lane [bicycles/h]	771	771	1000	1000
d_b, Bicycle Delay [s]	13,21	13,21	8,75	8,75
I_b,int, Bicycle LOS Score for Intersection	3,238	3,690	3,715	2,567
Bicycle LOS	C	D	D	B

Sequence

Ring 1	-	2	-	4	-	-	-	-	-	-	-	-	-	-	-	-
Ring 2	-	6	-	8	-	-	-	-	-	-	-	-	-	-	-	-
Ring 3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Ring 4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-



Intersection Level Of Service Report
Intersection 12: Andrew St/ Paul Kruger St

Control Type:	Two-way stop	Delay (sec / veh):	65,6
Analysis Method:	HCM 6th Edition	Level Of Service:	F
Analysis Period:	15 minutes	Volume to Capacity (v/c):	0,191

Intersection Setup

Name	Paul Kruger St.		Old Pretoria Rd		Andrew St.	
Approach	Northbound		Eastbound		Westbound	
Lane Configuration						
Turning Movement	Left	Right	Thru	Right	Left	Thru
Lane Width [m]	3,70	3,70	3,70	3,70	3,70	3,70
No. of Lanes in Entry Pocket	1	0	0	0	0	0
Entry Pocket Length [m]	200,00	30,48	30,48	30,48	30,48	30,48
No. of Lanes in Exit Pocket	0	0	0	0	1	0
Exit Pocket Length [m]	0,00	0,00	0,00	0,00	15,00	0,00
Speed [km/h]	60,00		60,00		60,00	
Grade [%]	0,00		0,00		0,00	
Crosswalk	Yes		Yes		Yes	

Volumes

Name	Paul Kruger St.		Old Pretoria Rd		Andrew St.	
Base Volume Input [veh/h]	503	12	630	328	19	446
Base Volume Adjustment Factor	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000
Heavy Vehicles Percentage [%]	2,00	2,00	2,00	2,00	2,00	2,00
Growth Factor	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000
In-Process Volume [veh/h]	0	0	0	0	0	0
Site-Generated Trips [veh/h]	0	0	0	0	0	0
Diverted Trips [veh/h]	0	0	0	0	0	0
Pass-by Trips [veh/h]	0	0	0	0	0	0
Existing Site Adjustment Volume [veh/h]	0	0	0	0	0	0
Other Volume [veh/h]	0	0	0	0	0	0
Total Hourly Volume [veh/h]	503	12	630	328	19	446
Peak Hour Factor	0,9500	0,9500	0,9500	0,9500	0,9500	0,9500
Other Adjustment Factor	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000
Total 15-Minute Volume [veh/h]	132	3	166	86	5	117
Total Analysis Volume [veh/h]	529	13	663	345	20	469
Pedestrian Volume [ped/h]	0		0		0	

Intersection Settings

Priority Scheme	Stop	Free	Free
Flared Lane			
Storage Area [veh]	0	0	0
Two-Stage Gap Acceptance	No		
Number of Storage Spaces in Median	0	0	0

Movement, Approach, & Intersection Results

V/C, Movement V/C Ratio	0,70	0,19	0,01	0,32	0,00	0,00
d_M, Delay for Movement [s/veh]	14,89	65,55	0,00	9,95	0,00	0,00
Movement LOS	B	F	A	A	A	A
95th-Percentile Queue Length [veh/ln]	2,36	3,09	0,70	1,40	0,00	0,00
95th-Percentile Queue Length [m/ln]	17,99	23,54	5,35	10,71	0,00	0,00
d_A, Approach Delay [s/veh]	16,11		3,41		0,00	
Approach LOS	C		A		A	
d_I, Intersection Delay [s/veh]	5,97					
Intersection LOS	F					

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Report File: N:\...\2. 2021 AM Peak (without taxis).pdf

Scenario 2 2021 AM Peak (without taxis)
2021/11/02

Turning Movement Volume: Summary

ID	Intersection Name	Northbound		Southbound		Westbound		Total Volume
		Left	Right	Thru	Right	Left	Thru	
1	D2296/ Friedenheim Rd	817	90	425	60	385	149	1926

ID	Intersection Name	Northbound			Southbound			Eastbound			Westbound			Total Volume
		Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	
3	Kragbron Rd/ Timerhout St	137	219	8	10	201	188	281	14	54	7	1	8	1128

ID	Intersection Name	Northbound			Southbound		Eastbound		Westbound		Total Volume
		Left	Thru	Right	Left	Right	Left	Thru	Thru	Right	
6	Bester St/ Corrier St	104	18	67	148	67	50	279	501	42	1276

ID	Intersection Name	Northbound			Southbound			Westbound			Total Volume
		Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	
7	Bester St/ Henshall St.	143	265	159	234	383	114	143	252	227	1920

ID	Intersection Name	Northbound		Southbound		Eastbound			Total Volume
		Thru	Right	Left	Thru	Left	Thru	Right	
8	Samora Machel Dr/ Henshall St.	471	330	225	259	387	1121	275	3068

ID	Intersection Name	Northbound		Southbound		Westbound			Total Volume
		Left	Thru	Thru	Right	Left	Thru	Right	
9	Bell St./Henshall St.	271	925	421	254	291	1780	563	4505

ID	Intersection Name	Northbound		Eastbound		Westbound		Total Volume
		Left	Right	Thru	Right	Left	Thru	
10	Andrew St/ Henshall St	193	46	117	217	1	48	622

ID	Intersection Name	Northbound			Southbound			Eastbound			Westbound			Total Volume
		Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	
11	Old Pretoria Rd/ Madiba Dr	467	2300	132	884	2167	629	886	1313	282	113	386	661	10220

ID	Intersection Name	Northbound		Eastbound		Westbound		Total Volume
		Left	Right	Thru	Right	Left	Thru	
12	Andrew St/ Paul Kruger St	503	12	630	328	19	446	1938

Vistro File: \...\Analysis of intersections in Mbombela.vistro | Scenario 2 2021 AM Peak (without taxis)
Report File: N:\...\2. 2021 AM Peak (without taxis).pdf | 2021/11/02

Turning Movement Volume: Detail

ID	Intersection Name	Volume Type	Northbound		Southbound		Westbound		Total Volume
			Left	Right	Thru	Right	Left	Thru	
1	D2296/ Friedenheim Rd	Final Base	817	90	425	60	385	149	1926
		Growth Factor	1,00	1,00	1,00	1,00	1,00	1,00	-
		In Process	0	0	0	0	0	0	0
		Net New Trips	0	0	0	0	0	0	0
		Other	0	0	0	0	0	0	0
		Future Total	**817**	**90**	**425**	**60**	**385**	**149**	**1926**

ID	Intersection Name	Volume Type	Northbound			Southbound			Eastbound			Westbound			Total Volume
			Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	
3	Kragbron Rd/ Timerhout St	Final Base	137	219	8	10	201	188	281	14	54	7	1	8	1128
		Growth Factor	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	-
		In Process	0	0	0	0	0	0	0	0	0	0	0	0	0
		Net New Trips	0	0	0	0	0	0	0	0	0	0	0	0	0
		Other	0	0	0	0	0	0	0	0	0	0	0	0	0
		Future Total	**137**	**219**	**8**	**10**	**201**	**188**	**281**	**14**	**54**	**7**	**1**	**8**	**1128**

ID	Intersection Name	Volume Type	Northbound			Southbound		Eastbound		Westbound		Total Volume
			Left	Thru	Right	Left	Right	Left	Thru	Thru	Right	
6	Bester St/ Corrier St	Final Base	109	19	70	156	71	53	294	527	44	1343
		Growth Factor	0,95	0,95	0,95	0,95	0,95	0,95	0,95	0,95	0,95	-
		In Process	0	0	0	0	0	0	0	0	0	0
		Net New Trips	0	0	0	0	0	0	0	0	0	0
		Other	0	0	0	0	0	0	0	0	0	0
		Future Total	**104**	**18**	**67**	**148**	**67**	**50**	**279**	**501**	**42**	**1276**

ID	Intersection Name	Volume Type	Northbound			Southbound			Westbound			Total Volume
			Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	
7	Bester St/ Henshall St.	Final Base	150	279	167	246	403	120	150	265	239	2019
		Growth Factor	0,95	0,95	0,95	0,95	0,95	0,95	0,95	0,95	0,95	-
		In Process	0	0	0	0	0	0	0	0	0	0
		Net New Trips	0	0	0	0	0	0	0	0	0	0
		Other	0	0	0	0	0	0	0	0	0	0
		Future Total	**143**	**265**	**159**	**234**	**383**	**114**	**143**	**252**	**227**	**1920**

ID	Intersection Name	Volume Type	Northbound		Southbound		Eastbound			Total Volume
			Thru	Right	Left	Thru	Left	Thru	Right	
8	Samora Machel Dr/ Henshall St.	Final Base	471	330	225	259	387	1121	275	3068
		Growth Factor	1,00	1,00	1,00	1,00	1,00	1,00	1,00	-
		In Process	0	0	0	0	0	0	0	0
		Net New Trips	0	0	0	0	0	0	0	0
		Other	0	0	0	0	0	0	0	0
		Future Total	**471**	**330**	**225**	**259**	**387**	**1121**	**275**	**3068**

ID	Intersection Name	Volume Type	Northbound		Southbound		Westbound			Total Volume
			Left	Thru	Thru	Right	Left	Thru	Right	
9	Bell St./Henshall St.	Final Base	271	925	421	254	291	1780	563	4505
		Growth Factor	1,00	1,00	1,00	1,00	1,00	1,00	1,00	-
		In Process	0	0	0	0	0	0	0	0
		Net New Trips	0	0	0	0	0	0	0	0
		Other	0	0	0	0	0	0	0	0
		Future Total	**271**	**925**	**421**	**254**	**291**	**1780**	**563**	**4505**

ID	Intersection Name	Volume Type	Northbound		Eastbound		Westbound		Total Volume
			Left	Right	Thru	Right	Left	Thru	
10	Andrew St/ Henshall St	Final Base	193	46	117	217	1	48	622
		Growth Factor	1,00	1,00	1,00	1,00	1,00	1,00	-
		In Process	0	0	0	0	0	0	0
		Net New Trips	0	0	0	0	0	0	0
		Other	0	0	0	0	0	0	0
		Future Total	**193**	**46**	**117**	**217**	**1**	**48**	**622**

ID	Intersection Name	Volume Type	Northbound			Southbound			Eastbound			Westbound			Total Volume
			Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	
11	Old Pretoria Rd/ Madiba Dr	Final Base	467	2300	132	884	2167	629	886	1313	282	113	386	661	10220
		Growth Factor	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	-
		In Process	0	0	0	0	0	0	0	0	0	0	0	0	0
		Net New Trips	0	0	0	0	0	0	0	0	0	0	0	0	0
		Other	0	0	0	0	0	0	0	0	0	0	0	0	0
		Future Total	**467**	**2300**	**132**	**884**	**2167**	**629**	**886**	**1313**	**282**	**113**	**386**	**661**	**10220**

ID	Intersection Name	Volume Type	Northbound		Eastbound		Westbound		Total Volume
			Left	Right	Thru	Right	Left	Thru	
12	Andrew St/ Paul Kruger St	Final Base	503	12	630	328	19	446	1938
		Growth Factor	1,00	1,00	1,00	1,00	1,00	1,00	-
		In Process	0	0	0	0	0	0	0
		Net New Trips	0	0	0	0	0	0	0
		Other	0	0	0	0	0	0	0
		Future Total	**503**	**12**	**630**	**328**	**19**	**446**	**1938**

Signal Warrants Report For Intersection 3: Kragbron Rd/ Timerhout St

Warrants Summary

Warrant	Name	Met?
#1	Eight Hour Vehicular Volume	Yes
#2	Four Hour Vehicular Volume	Yes
#3	Peak Hour	Yes

Intersection Warrants Parameters

Major Approaches	S, N
Minor Approaches	E, W
Speed > 40mph	Yes
Population < 10,000	No
Warrant Factor	70%

Warrant Analysis Traffic Volumes

Hour	**Major Streets**		**Minor Streets**	
	S	N	E	W
1	364	399	16	349
2	353	387	16	339
3	346	379	15	332
4	324	355	14	311
5	288	315	13	276
6	284	311	12	272
7	280	307	12	269
8	255	279	11	244
9	251	275	11	241
10	248	271	11	237
11	215	235	9	206
12	200	219	9	192
13	197	215	9	188
14	146	160	6	140
15	146	160	6	140
16	102	112	4	98
17	58	64	3	56
18	58	64	3	56
19	33	36	1	31
20	18	20	1	17
21	11	12	0	10
22	4	4	0	3
23	4	4	0	3
24	4	4	0	3

Warrant Analysis by Hour

Hour	Major Streets		Minor Street		Warrant 1 Condition A				Warrant 1 Condition B				Warrant 2	Warrant 3
	Number	Volume	Number	Volume	100%	80%	70%	56%	100%	80%	70%	56%		Condition B
1	2	763	2	349	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes
2	2	740	2	339	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes
3	2	725	2	332	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes
4	2	679	2	311	Yes	Yes	Yes	Yes	No	No	Yes	Yes	Yes	Yes
5	2	603	2	276	Yes	Yes	Yes	Yes	No	No	No	Yes	Yes	No
6	2	595	2	272	No	Yes	Yes	Yes	No	No	No	Yes	Yes	No
7	2	587	2	269	No	Yes	Yes	Yes	No	No	No	Yes	Yes	No
8	2	534	2	244	No	Yes	Yes	Yes	No	No	No	Yes	Yes	No
9	2	526	2	241	No	Yes	Yes	Yes	No	No	No	Yes	Yes	No
10	2	519	2	237	No	Yes	Yes	Yes	No	No	No	Yes	Yes	No
11	2	450	2	206	No	No	Yes	Yes	No	No	No	No	No	No
12	2	419	2	192	No	No	No	Yes	No	No	No	No	No	No
13	2	412	2	188	No	No	No	Yes	No	No	No	No	No	No
14	2	306	2	140	No	No	No	No	No	No	No	No	No	No
15	2	306	2	140	No	No	No	No	No	No	No	No	No	No
16	2	214	2	98	No	No	No	No	No	No	No	No	No	No
17	2	122	2	56	No	No	No	No	No	No	No	No	No	No
18	2	122	2	56	No	No	No	No	No	No	No	No	No	No
19	2	69	2	31	No	No	No	No	No	No	No	No	No	No
20	2	38	2	17	No	No	No	No	No	No	No	No	No	No
21	2	23	2	10	No	No	No	No	No	No	No	No	No	No
22	2	8	2	3	No	No	No	No	No	No	No	No	No	No
23	2	8	2	3	No	No	No	No	No	No	No	No	No	No
24	2	8	2	3	No	No	No	No	No	No	No	No	No	No
Hours Met					5	10	11	13	0	3	4	10	10	4

Warrant 3 Condition A

Orientation	E	W
Total Stopped Delay Per Vehicle on Minor Approach (s)	10,9	13,7
Number of Lanes on Minor Street Approach	1	2
VehicleHours of Stopped Delay on Minor Approach ([h]h:mm)	0:02	1:19
Delay Condition Met	No	No
Volume on Minor Street Approach During Same Hour	16	349
High Minor Volume Condition Met	No	Yes
Total Entering Volume on All Approaches During Same Hour	1128	1128
Number of Approaches on Intersection	4	4
Total Volume Condition Met	Yes	Yes
Warrant Met for Approach	No	No
Warrant Met for Intersection	**No**	

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Signal Warrants Report For Intersection 10: Andrew St/ Henshall St

Warrants Summary

Warrant	Name	Met?
#1	Eight Hour Vehicular Volume	No
#2	Four Hour Vehicular Volume	No
#3	Peak Hour	No

Intersection Warrants Parameters

Major Approaches	S, W
Minor Approaches	E
Speed > 40mph	Yes
Population < 10,000	No
Warrant Factor	70%

Warrant Analysis Traffic Volumes

Hour	Major Streets		Minor Streets
	S	W	E
1	239	334	49
2	232	324	48
3	227	317	47
4	213	297	44
5	189	264	39
6	186	261	38
7	184	257	38
8	167	234	34
9	165	230	34
10	163	227	33
11	141	197	29
12	131	184	27
13	129	180	26
14	96	134	20
15	96	134	20
16	67	94	14
17	38	53	8
18	38	53	8
19	22	30	4
20	12	17	2
21	7	10	1
22	2	3	0
23	2	3	0
24	2	3	0

Warrant Analysis by Hour

Hour	Major Streets		Minor Street		Warrant 1 Condition A				Warrant 1 Condition B				Warrant 2	Warrant 3
	Number	Volume	Number	Volume	100%	80%	70%	56%	100%	80%	70%	56%		Condition B
1	2	573	1	49	No	No	No	No	No	No	No	Yes	No	No
2	2	556	1	48	No	No	No	No	No	No	No	Yes	No	No
3	2	544	1	47	No	No	No	No	No	No	No	Yes	No	No
4	2	510	1	44	No	No	No	No	No	No	No	Yes	No	No
5	2	453	1	39	No	No	No	No	No	No	No	No	No	No
6	2	447	1	38	No	No	No	No	No	No	No	No	No	No
7	2	441	1	38	No	No	No	No	No	No	No	No	No	No
8	2	401	1	34	No	No	No	No	No	No	No	No	No	No
9	2	395	1	34	No	No	No	No	No	No	No	No	No	No
10	2	390	1	33	No	No	No	No	No	No	No	No	No	No
11	2	338	1	29	No	No	No	No	No	No	No	No	No	No
12	2	315	1	27	No	No	No	No	No	No	No	No	No	No
13	2	309	1	26	No	No	No	No	No	No	No	No	No	No
14	2	230	1	20	No	No	No	No	No	No	No	No	No	No
15	2	230	1	20	No	No	No	No	No	No	No	No	No	No
16	2	161	1	14	No	No	No	No	No	No	No	No	No	No
17	2	91	1	8	No	No	No	No	No	No	No	No	No	No
18	2	91	1	8	No	No	No	No	No	No	No	No	No	No
19	2	52	1	4	No	No	No	No	No	No	No	No	No	No
20	2	29	1	2	No	No	No	No	No	No	No	No	No	No
21	2	17	1	1	No	No	No	No	No	No	No	No	No	No
22	2	5	1	0	No	No	No	No	No	No	No	No	No	No
23	2	5	1	0	No	No	No	No	No	No	No	No	No	No
24	2	5	1	0	No	No	No	No	No	No	No	No	No	No
Hours Met					0	0	0	0	0	0	0	4	0	0

Warrant 3 Condition A

Orientation	E
Total Stopped Delay Per Vehicle on Minor Approach (s)	8,4
Number of Lanes on Minor Street Approach	1
VehicleHours of Stopped Delay on Minor Approach ([h]h:mm)	0:06
Delay Condition Met	No
Volume on Minor Street Approach During Same Hour	49
High Minor Volume Condition Met	No
Total Entering Volume on All Approaches During Same Hour	622
Number of Approaches on Intersection	3
Total Volume Condition Met	No
Warrant Met for Approach	No
Warrant Met for Intersection	**No**

Signal Warrants Report For Intersection 12: Andrew St/ Paul Kruger St

Warrants Summary

Warrant	Name	Met?
#1	Eight Hour Vehicular Volume	Yes
#2	Four Hour Vehicular Volume	Yes
#3	Peak Hour	Yes

Intersection Warrants Parameters

Major Approaches	E, W
Minor Approaches	S
Speed > 40mph	Yes
Population < 10,000	No
Warrant Factor	70%

Warrant Analysis Traffic Volumes

Hour	Major Streets		Minor Streets
	E	W	S
1	465	958	515
2	451	929	500
3	442	910	489
4	414	853	458
5	367	757	407
6	363	747	402
7	358	738	397
8	326	671	361
9	321	661	355
10	316	651	350
11	274	565	304
12	256	527	283
13	251	517	278
14	186	383	206
15	186	383	206
16	130	268	144
17	74	153	82
18	74	153	82
19	42	86	46
20	23	48	26
21	14	29	15
22	5	10	5
23	5	10	5
24	5	10	5

Warrant Analysis by Hour

Hour	Major Streets		Minor Street		Warrant 1 Condition A				Warrant 1 Condition B				Warrant 2	Warrant 3
	Number	Volume	Number	Volume	100%	80%	70%	56%	100%	80%	70%	56%		Condition B
1	2	1423	2	515	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
2	2	1380	2	500	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
3	2	1352	2	489	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
4	2	1267	2	458	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
5	2	1124	2	407	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
6	2	1110	2	402	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
7	2	1096	2	397	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
8	2	997	2	361	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
9	2	982	2	355	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
10	2	967	2	350	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
11	2	839	2	304	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes
12	2	783	2	283	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes
13	2	768	2	278	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes
14	2	569	2	206	No	Yes	Yes	Yes	No	No	No	Yes	Yes	No
15	2	569	2	206	No	Yes	Yes	Yes	No	No	No	Yes	Yes	No
16	2	398	2	144	No	No	No	Yes	No	No	No	No	No	No
17	2	227	2	82	No	No	No	No	No	No	No	No	No	No
18	2	227	2	82	No	No	No	No	No	No	No	No	No	No
19	2	128	2	46	No	No	No	No	No	No	No	No	No	No
20	2	71	2	26	No	No	No	No	No	No	No	No	No	No
21	2	43	2	15	No	No	No	No	No	No	No	No	No	No
22	2	15	2	5	No	No	No	No	No	No	No	No	No	No
23	2	15	2	5	No	No	No	No	No	No	No	No	No	No
24	2	15	2	5	No	No	No	No	No	No	No	No	No	No
Hours Met					13	15	15	16	10	13	13	15	15	13

Warrant 3 Condition A

Orientation	S
Total Stopped Delay Per Vehicle on Minor Approach (s)	16,1
Number of Lanes on Minor Street Approach	2
VehicleHours of Stopped Delay on Minor Approach ([h]h:mm)	2:18
Delay Condition Met	No
Volume on Minor Street Approach During Same Hour	515
High Minor Volume Condition Met	Yes
Total Entering Volume on All Approaches During Same Hour	1938
Number of Approaches on Intersection	3
Total Volume Condition Met	Yes
Warrant Met for Approach	No
Warrant Met for Intersection	**No**

Study Intersections

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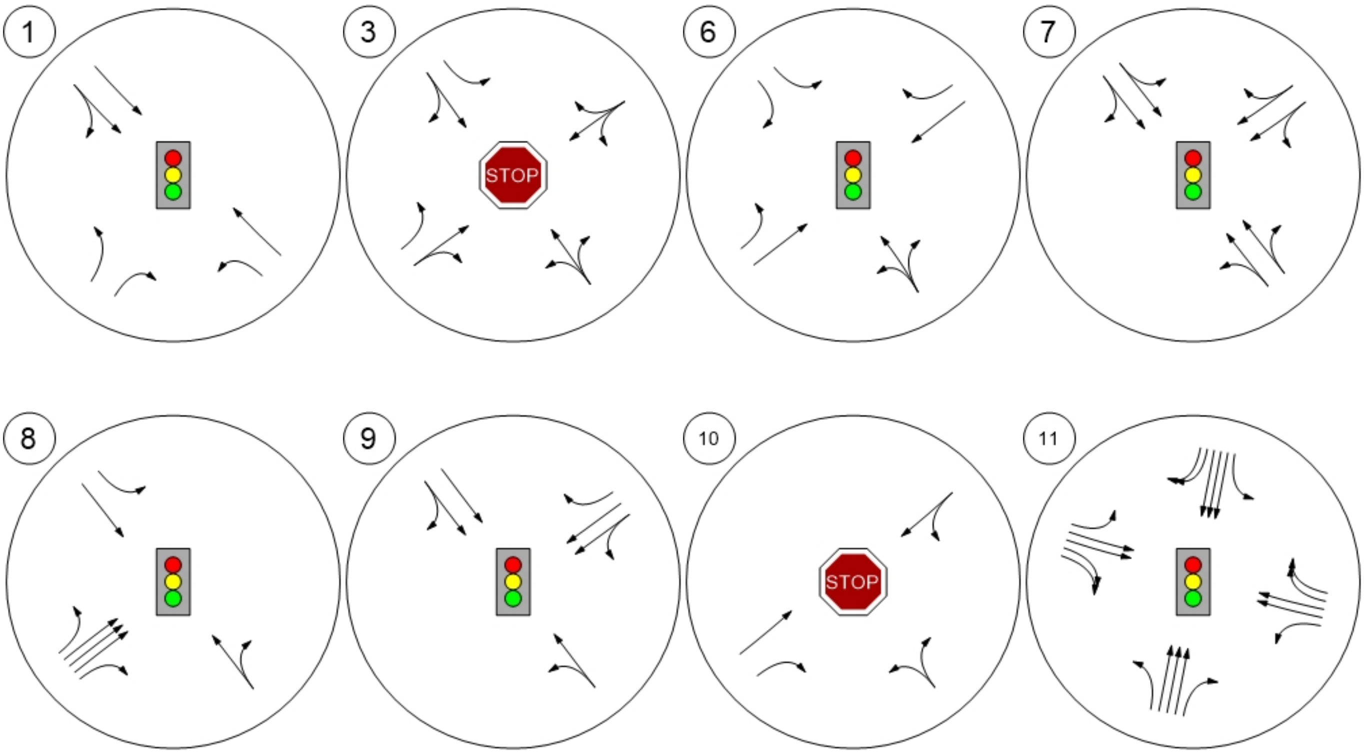
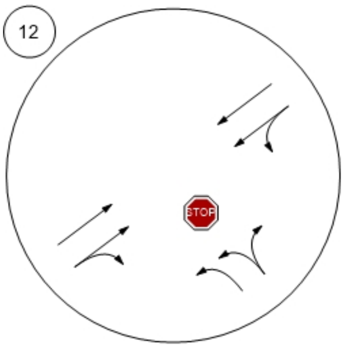
Lane Configuration and Traffic Control



Lane Configuration and Traffic Control



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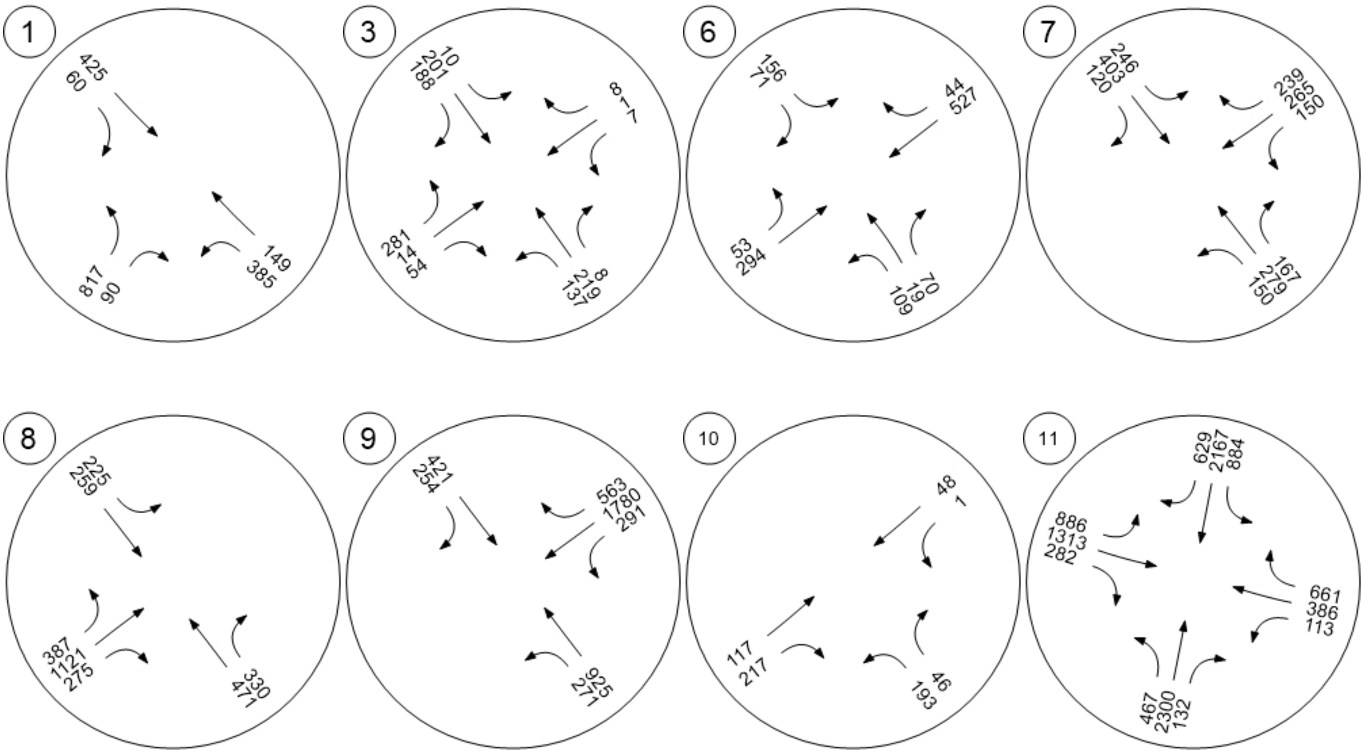
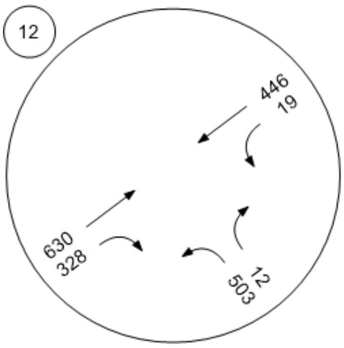
Traffic Volume - Base Volume



Traffic Volume - Base Volume



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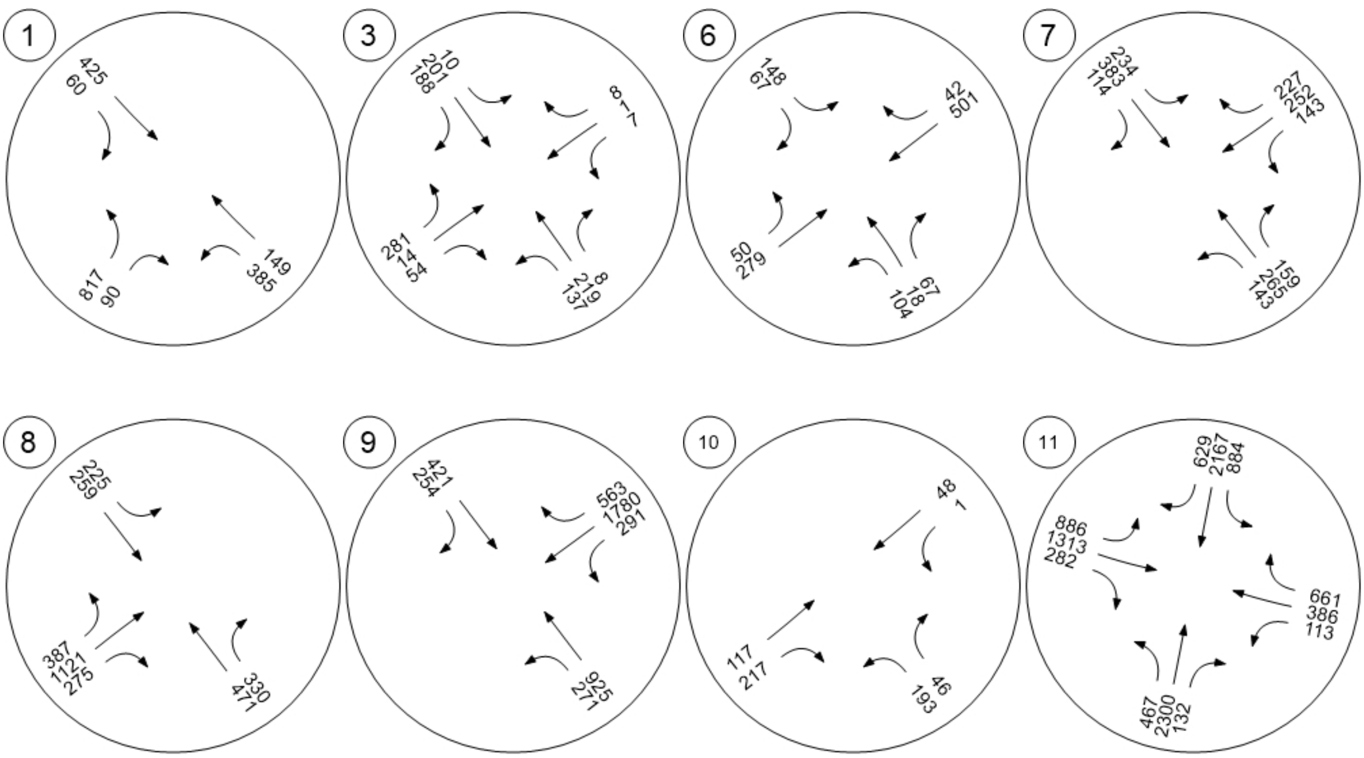
Traffic Volume - Future Total Volume



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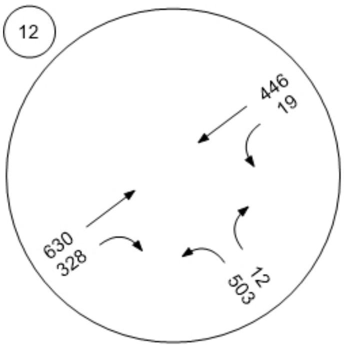
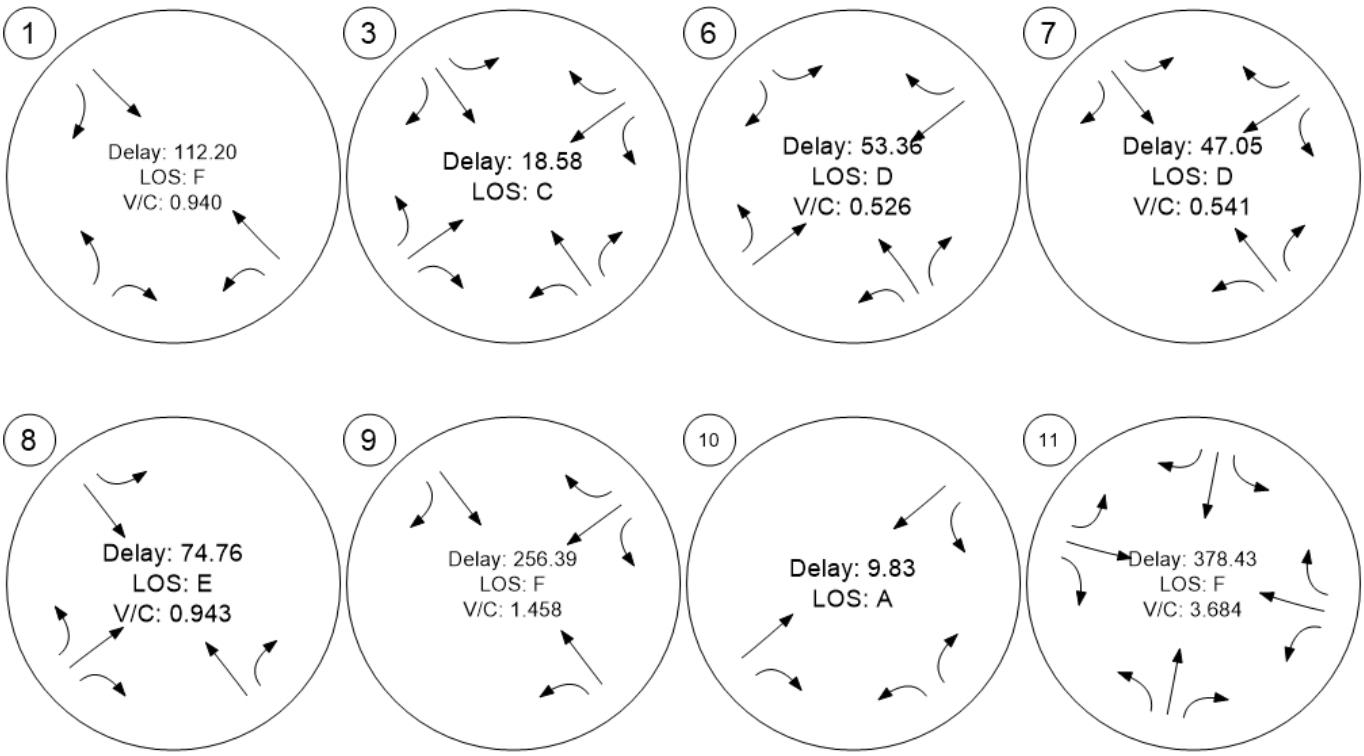
Traffic Volume - Future Total Volume



Traffic Conditions



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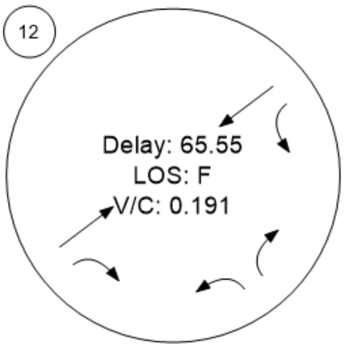
Version 2021 (SP 0-6)

Traffic Conditions



APPENDIX 6.3: PM Peak with Mini-bus Taxis

Vistro File: \...\Analysis of intersections in Mbombela.vistro
Report File: N:\...\3. 2021 PM Peak (with taxis).pdf

Scenario 3 2021 PM Peak (with taxis)
2021/11/02

Intersection Analysis Summary

ID	Intersection Name	Control Type	Method	Worst Mvmt	V/C	Delay (s/veh)	LOS
1	D2296/ Friedenheim Rd	Signalized	HCM 6th Edition	WB Left	1,036	149,1	F
3	Kragbron Rd/ Timerhout St	All-way stop	HCM 6th Edition	SB Right	1,318	87,8	F
6	Bester St/ Corrier St	Signalized	HCM 6th Edition	NB Right	0,589	59,4	E
7	Bester St/ Henshall St.	Signalized	HCM 6th Edition	NB Right	0,912	63,6	E
8	Samora Machel Dr/ Henshall St.	Signalized	HCM 6th Edition	EB Thru	1,110	123,3	F
9	Bell St./Henshall St.	Signalized	HCM 6th Edition	SB Right	1,472	151,0	F
10	Andrew St/ Henshall St	All-way stop	HCM 6th Edition	EB Right	0,614	14,4	B
11	Old Pretoria Rd/ Madiba Dr	Signalized	HCM 6th Edition	SB Right	3,182	402,3	F
12	Andrew St/ Paul Kruger St	Two-way stop	HCM 6th Edition	NB Right	0,507	338,3	F

V/C, Delay, LOS: For two-way stop, these values are taken from the movement with the worst (highest) delay value.
For all other control types, they are taken for the whole intersection.

Intersection Level Of Service Report
Intersection 1: D2296/ Friedenheim Rd

Control Type:	Signalized	Delay (sec / veh):	149,1
Analysis Method:	HCM 6th Edition	Level Of Service:	F
Analysis Period:	15 minutes	Volume to Capacity (v/c):	1,036

Intersection Setup

Name	Friedenheim St		D2296		D2296	
Approach	Northbound		Southbound		Westbound	
Lane Configuration						
Turning Movement	Left	Right	Thru	Right	Left	Thru
Lane Width [m]	3,70	3,70	3,70	3,70	3,70	3,70
No. of Lanes in Entry Pocket	0	0	1	0	0	0
Entry Pocket Length [m]	30,48	30,48	60,00	30,48	30,48	30,48
No. of Lanes in Exit Pocket	0	0	0	0	0	0
Exit Pocket Length [m]	0,00	0,00	0,00	0,00	0,00	0,00
Speed [km/h]	48,28		60,00		60,00	
Grade [%]	0,00		0,00		0,00	
Curb Present	No		No		No	
Crosswalk	No		No		No	

Volumes

Name	Friedenheim St		D2296		D2296	
Base Volume Input [veh/h]	254	112	473	66	1070	699
Base Volume Adjustment Factor	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000
Heavy Vehicles Percentage [%]	2,00	2,00	2,00	2,00	2,00	2,00
Growth Factor	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000
In-Process Volume [veh/h]	0	0	0	0	0	0
Site-Generated Trips [veh/h]	0	0	0	0	0	0
Diverted Trips [veh/h]	0	0	0	0	0	0
Pass-by Trips [veh/h]	0	0	0	0	0	0
Existing Site Adjustment Volume [veh/h]	0	0	0	0	0	0
Other Volume [veh/h]	0	0	0	0	0	0
Left-Turn on Red Volume [veh/h]	0	0	0	0	0	0
Total Hourly Volume [veh/h]	254	112	473	66	1070	699
Peak Hour Factor	0,9500	0,9500	0,9500	0,9500	0,9500	0,9500
Other Adjustment Factor	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000
Total 15-Minute Volume [veh/h]	67	29	124	17	282	184
Total Analysis Volume [veh/h]	267	118	498	69	1126	736
Presence of On-Street Parking	No	No	No	No	No	No
On-Street Parking Maneuver Rate [/h]	0	0	0	0	0	0
Local Bus Stopping Rate [/h]	0	0	0	0	0	0
v_do, Outbound Pedestrian Volume crossing	0		0		0	
v_di, Inbound Pedestrian Volume crossing m	0		0		0	
v_co, Outbound Pedestrian Volume crossing	0		0		0	
v_ci, Inbound Pedestrian Volume crossing mi	0		0		0	
v_ab, Corner Pedestrian Volume [ped/h]	0		0		0	
Bicycle Volume [bicycles/h]	0		0		0	

Intersection Settings

Located in CBD	No
Signal Coordination Group	-
Cycle Length [s]	180
Coordination Type	Time of Day Pattern Coordinated
Actuation Type	Fully actuated
Offset [s]	0,0
Offset Reference	Lead Green - Beginning of First Green
Permissive Mode	SingleBand
Lost time [s]	0,00

Phasing & Timing

Control Type	Permissive	Permissive	Permissive	Permissive	Permissive	Permissive
Signal Group	0	1	2	0	0	4
Auxiliary Signal Groups						
Lead / Lag	-	Lead	-	-	-	-
Minimum Green [s]	0	5	10	0	0	10
Maximum Green [s]	0	30	30	0	0	30
Amber [s]	0,0	3,0	3,0	0,0	0,0	3,0
All red [s]	0,0	1,0	1,0	0,0	0,0	1,0
Split [s]	0	29	32	0	0	119
Vehicle Extension [s]	0,0	3,0	3,0	0,0	0,0	3,0
Walk [s]	0	5	5	0	0	5
Pedestrian Clearance [s]	0	10	10	0	0	10
Delayed Vehicle Green [s]	0,0	0,0	0,0	0,0	0,0	0,0
Rest In Walk		No	No			No
I1, Start-Up Lost Time [s]	0,0	2,0	2,0	0,0	0,0	2,0
I2, Clearance Lost Time [s]	0,0	2,0	2,0	0,0	0,0	2,0
Minimum Recall		No	No			No
Maximum Recall		No	No			No
Pedestrian Recall		No	No			No
Detector Location [m]	0,0	0,0	0,0	0,0	0,0	0,0
Detector Length [m]	0,0	0,0	0,0	0,0	0,0	0,0
I, Upstream Filtering Factor	1,00	1,00	1,00	1,00	1,00	1,00

Exclusive Pedestrian Phase

Pedestrian Signal Group	0
Pedestrian Walk [s]	0
Pedestrian Clearance [s]	0

Lane Group Calculations

Lane Group	L	R	C	C	L	C
C, Cycle Length [s]	70	70	70	70	70	70
L, Total Lost Time per Cycle [s]	4,00	4,00	4,00	4,00	4,00	4,00
l1_p, Permitted Start-Up Lost Time [s]	0,00	0,00	0,00	0,00	0,00	0,00
l2, Clearance Lost Time [s]	2,00	2,00	2,00	2,00	2,00	2,00
g_i, Effective Green Time [s]	14	14	14	14	30	30
g / C, Green / Cycle	0,20	0,20	0,20	0,20	0,43	0,43
(v / s)_i Volume / Saturation Flow Rate	0,17	0,07	0,16	0,16	0,71	0,39
s, saturation flow rate [veh/h]	1589	1781	1702	1848	1589	1870
c, Capacity [veh/h]	324	363	339	369	678	797
d1, Uniform Delay [s]	26,81	23,89	26,84	26,85	20,19	19,10
k, delay calibration	0,11	0,11	0,11	0,11	0,50	0,39
I, Upstream Filtering Factor	1,00	1,00	1,00	1,00	1,00	1,00
d2, Incremental Delay [s]	5,27	0,51	4,38	4,08	304,41	14,98
d3, Initial Queue Delay [s]	0,00	0,00	0,00	0,00	0,00	0,00
Rp, platoon ratio	1,00	1,00	1,00	1,00	1,00	1,00
PF, progression factor	1,00	1,00	1,00	1,00	1,00	1,00

Lane Group Results

X, volume / capacity	0,82	0,33	0,80	0,80	1,66	0,92
d, Delay for Lane Group [s/veh]	32,08	24,40	31,21	30,93	324,60	34,08
Lane Group LOS	C	C	C	C	F	C
Critical Lane Group	Yes	No	No	Yes	Yes	No
50th-Percentile Queue Length [veh/ln]	4,54	1,65	4,42	4,79	66,70	12,99
50th-Percentile Queue Length [m/ln]	34,58	12,59	33,72	36,47	508,25	98,97
95th-Percentile Queue Length [veh/ln]	8,03	2,97	7,87	8,37	105,07	18,90
95th-Percentile Queue Length [m/ln]	61,20	22,66	60,01	63,82	800,63	144,01

Movement, Approach, & Intersection Results

d_M, Delay for Movement [s/veh]	32,08	24,40	31,08	30,93	324,60	34,08
Movement LOS	C	C	C	C	F	C
d_A, Approach Delay [s/veh]	29,73		31,07		209,76	
Approach LOS	C		C		F	
d_I, Intersection Delay [s/veh]	149,12					
Intersection LOS	F					
Intersection V/C	1,036					

Other Modes

g_Walk,mi, Effective Walk Time [s]	0,0	0,0	0,0
M_corner, Corner Circulation Area [m²/ped]	0,00	0,00	0,00
M_CW, Crosswalk Circulation Area [m²/ped]	0,00	0,00	0,00
d_p, Pedestrian Delay [s]	0,00	0,00	0,00
I_p,int, Pedestrian LOS Score for Intersection	0,000	0,000	0,000
Crosswalk LOS	F	F	F
s_b, Saturation Flow Rate of the bicycle lane	2000	2000	2000
c_b, Capacity of the bicycle lane [bicycles/h]	712	797	3273
d_b, Bicycle Delay [s]	14,58	12,71	14,24
I_b,int, Bicycle LOS Score for Intersection	1,560	2,027	4,632
Bicycle LOS	A	B	E

Sequence

Ring 1	1	2	-	4	-	-	-	-	-	-	-	-	-	-	-	-
Ring 2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Ring 3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Ring 4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Intersection Level Of Service Report
Intersection 3: Kragbron Rd/ Timerhout St

Control Type:	All-way stop	Delay (sec / veh):	87,8
Analysis Method:	HCM 6th Edition	Level Of Service:	F
Analysis Period:	15 minutes	Volume to Capacity (v/c):	1,318

Intersection Setup

Name	Kragbron Rd			Kragbron Rd			Bester St.			Timerhout St		
Approach	Northbound			Southbound			Eastbound			Westbound		
Lane Configuration												
Turning Movement	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right
Lane Width [m]	3,70	3,70	3,70	3,70	3,70	3,70	3,70	3,70	3,70	3,70	3,70	3,70
No. of Lanes in Entry Pocket	0	0	0	1	0	0	1	0	0	0	0	0
Entry Pocket Length [m]	30,48	30,48	30,48	110,00	30,48	30,48	60,00	30,48	30,48	30,48	30,48	30,48
No. of Lanes in Exit Pocket	0	0	0	0	0	0	0	0	0	0	0	0
Exit Pocket Length [m]	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
Speed [km/h]	60,00			48,28			60,00			60,00		
Grade [%]	0,00			0,00			0,00			0,00		
Crosswalk	No			No			No			No		

Volumes

Name	Kragbron Rd			Kragbron Rd			Bester St.			Timerhout St		
Base Volume Input [veh/h]	95	163	6	19	79	525	525	9	202	14	14	9
Base Volume Adjustment Factor	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000
Heavy Vehicles Percentage [%]	2,00	2,00	2,00	2,00	2,00	2,00	2,00	2,00	2,00	2,00	2,00	2,00
Growth Factor	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000
In-Process Volume [veh/h]	0	0	0	0	0	0	0	0	0	0	0	0
Site-Generated Trips [veh/h]	0	0	0	0	0	0	0	0	0	0	0	0
Diverted Trips [veh/h]	0	0	0	0	0	0	0	0	0	0	0	0
Pass-by Trips [veh/h]	0	0	0	0	0	0	0	0	0	0	0	0
Existing Site Adjustment Volume [veh/h]	0	0	0	0	0	0	0	0	0	0	0	0
Other Volume [veh/h]	0	0	0	0	0	0	0	0	0	0	0	0
Total Hourly Volume [veh/h]	95	163	6	19	79	525	525	9	202	14	14	9
Peak Hour Factor	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000
Other Adjustment Factor	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000
Total 15-Minute Volume [veh/h]	24	41	2	5	20	131	131	2	51	4	4	2
Total Analysis Volume [veh/h]	95	163	6	19	79	525	525	9	202	14	14	9
Pedestrian Volume [ped/h]	0			0			0			0		

Intersection Settings

Lanes

Capacity per Entry Lane [veh/h]	477	538	604	553	469	414
Degree of Utilization, x	0,55	0,04	1,32	0,95	0,45	0,09

Movement, Approach, & Intersection Results

95th-Percentile Queue Length [veh]	3,30	0,11	26,70	12,39	2,29	0,29
95th-Percentile Queue Length [m]	25,16	0,84	203,44	94,45	17,48	2,23
Approach Delay [s/veh]	19,47	175,74		41,69		12,56
Approach LOS	C	F		E		B
Intersection Delay [s/veh]	87,82					
Intersection LOS	F					

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Intersection Level Of Service Report
Intersection 6: Bester St/ Corrier St

Control Type:	Signalized	Delay (sec / veh):	59,4
Analysis Method:	HCM 6th Edition	Level Of Service:	E
Analysis Period:	15 minutes	Volume to Capacity (v/c):	0,589

Intersection Setup

Name	Currie St.			Currie St.			Bester St.			Bester St.		
Approach	Northbound			Southbound			Eastbound			Westbound		
Lane Configuration												
Turning Movement	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right
Lane Width [m]	3,70	3,70	3,70	3,70	3,70	3,70	3,70	3,70	3,66	3,66	3,70	3,70
No. of Lanes in Entry Pocket	0	0	0	0	0	1	0	0	0	0	0	1
Entry Pocket Length [m]	30,48	30,48	30,48	30,48	30,48	10,00	30,48	30,48	30,48	30,48	30,48	60,00
No. of Lanes in Exit Pocket	0	0	0	0	0	0	0	0	0	0	0	0
Exit Pocket Length [m]	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
Speed [km/h]	60,00			60,00			60,00			60,00		
Grade [%]	0,00			0,00			0,00			0,00		
Curb Present	No			No			No			No		
Crosswalk	Yes			Yes			Yes			Yes		

Volumes

Name	Currie St.			Currie St.			Bester St.			Bester St.		
Base Volume Input [veh/h]	109	25	181	59	0	38	78	401	0	0	631	19
Base Volume Adjustment Factor	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000
Heavy Vehicles Percentage [%]	2,00	2,00	2,00	2,00	2,00	2,00	2,00	2,00	2,00	2,00	2,00	2,00
Growth Factor	0,9500	0,9500	0,9500	0,9500	1,0000	0,9500	0,9500	0,9500	1,0000	1,0000	0,9500	0,9500
In-Process Volume [veh/h]	0	0	0	0	0	0	0	0	0	0	0	0
Site-Generated Trips [veh/h]	0	0	0	0	0	0	0	0	0	0	0	0
Diverted Trips [veh/h]	0	0	0	0	0	0	0	0	0	0	0	0
Pass-by Trips [veh/h]	0	0	0	0	0	0	0	0	0	0	0	0
Existing Site Adjustment Volume [veh/h]	0	0	0	0	0	0	0	0	0	0	0	0
Other Volume [veh/h]	0	0	0	0	0	0	0	0	0	0	0	0
Left-Turn on Red Volume [veh/h]	0	0	0	0	0	0	0	0	0	0	0	0
Total Hourly Volume [veh/h]	104	24	172	56	0	36	74	381	0	0	599	18
Peak Hour Factor	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000
Other Adjustment Factor	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000
Total 15-Minute Volume [veh/h]	26	6	43	14	0	9	19	95	0	0	150	5
Total Analysis Volume [veh/h]	104	24	172	56	0	36	74	381	0	0	599	18
Presence of On-Street Parking	No		No	No		No	No		No	No		No
On-Street Parking Maneuver Rate [/h]	0	0	0	0	0	0	0	0	0	0	0	0
Local Bus Stopping Rate [/h]	0	0	0	0	0	0	0	0	0	0	0	0
v_do, Outbound Pedestrian Volume crossing		0			0			0			0	
v_di, Inbound Pedestrian Volume crossing m		0			0			0			0	
v_co, Outbound Pedestrian Volume crossing		0			0			0			0	
v_ci, Inbound Pedestrian Volume crossing mi		0			0			0			0	
v_ab, Corner Pedestrian Volume [ped/h]		0			0			0			0	
Bicycle Volume [bicycles/h]		0			0			0			0	

Intersection Settings

Located in CBD	Yes
Signal Coordination Group	-
Cycle Length [s]	240
Coordination Type	Time of Day Pattern Coordinated
Actuation Type	Fixed time
Offset [s]	0,0
Offset Reference	Lead Green - Beginning of First Green
Permissive Mode	SingleBand
Lost time [s]	0,00

Phasing & Timing

Control Type	Permiss	Permiss	Permiss	Permiss	Permiss	Permiss	Permiss	Permiss	Permiss	Permiss	Permiss	Permiss
Signal Group	0	6	0	0	0	5	0	8	0	0	4	0
Auxiliary Signal Groups												
Lead / Lag	-	-	-	-	-	Lead	-	-	-	-	-	-
Minimum Green [s]	0	10	0	0	0	5	0	10	0	0	10	0
Maximum Green [s]	0	30	0	0	0	30	0	30	0	0	30	0
Amber [s]	0,0	3,0	0,0	0,0	0,0	3,0	0,0	3,0	0,0	0,0	3,0	0,0
All red [s]	0,0	1,0	0,0	0,0	0,0	1,0	0,0	1,0	0,0	0,0	1,0	0,0
Split [s]	0	53	0	0	0	50	0	137	0	0	137	0
Vehicle Extension [s]	0,0	3,0	0,0	0,0	0,0	3,0	0,0	3,0	0,0	0,0	3,0	0,0
Walk [s]	0	5	0	0	0	5	0	5	0	0	5	0
Pedestrian Clearance [s]	0	12	0	0	0	12	0	12	0	0	6	0
Delayed Vehicle Green [s]	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Rest In Walk		No				No		No			No	
I1, Start-Up Lost Time [s]	0,0	2,0	0,0	0,0	0,0	2,0	0,0	2,0	0,0	0,0	2,0	0,0
I2, Clearance Lost Time [s]	0,0	2,0	0,0	0,0	0,0	2,0	0,0	2,0	0,0	0,0	2,0	0,0
Minimum Recall		No				No		No			No	
Maximum Recall		No				No		No			No	
Pedestrian Recall		No				No		No			No	
Detector Location [m]	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Detector Length [m]	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
I, Upstream Filtering Factor	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00

Exclusive Pedestrian Phase

Pedestrian Signal Group	0
Pedestrian Walk [s]	0
Pedestrian Clearance [s]	0

Lane Group Calculations

Lane Group	C	L	R	L	C	C	R
C, Cycle Length [s]	240	240	240	240	240	240	240
L, Total Lost Time per Cycle [s]	4,00	4,00	4,00	4,00	4,00	4,00	4,00
l1_p, Permitted Start-Up Lost Time [s]	0,00	0,00	0,00	0,00	0,00	0,00	2,00
l2, Clearance Lost Time [s]	2,00	2,00	2,00	2,00	2,00	2,00	2,00
g_i, Effective Green Time [s]	49	46	46	133	133	133	133
g / C, Green / Cycle	0,20	0,19	0,19	0,55	0,55	0,55	0,55
(v / s)_i Volume / Saturation Flow Rate	0,19	0,04	0,02	0,05	0,23	0,36	0,02
s, saturation flow rate [veh/h]	1544	1431	1603	1431	1683	1683	902
c, Capacity [veh/h]	315	274	307	793	933	933	405
d1, Uniform Delay [s]	94,33	81,60	80,21	25,15	30,83	37,03	41,85
k, delay calibration	0,50	0,50	0,50	0,50	0,50	0,50	0,50
I, Upstream Filtering Factor	1,00	1,00	1,00	1,00	1,00	1,00	1,00
d2, Incremental Delay [s]	39,72	1,68	0,78	0,23	1,33	3,39	0,21
d3, Initial Queue Delay [s]	0,00	0,00	0,00	0,00	0,00	0,00	0,00
Rp, platoon ratio	1,00	1,00	1,00	1,00	1,00	1,00	1,00
PF, progression factor	1,00	1,00	1,00	1,00	1,00	1,00	1,00

Lane Group Results

X, volume / capacity	0,95	0,20	0,12	0,09	0,41	0,64	0,04
d, Delay for Lane Group [s/veh]	134,05	83,28	80,99	25,39	32,16	40,43	42,06
Lane Group LOS	F	F	F	C	C	D	D
Critical Lane Group	Yes	Yes	No	No	No	Yes	No
50th-Percentile Queue Length [veh/ln]	22,04	3,08	1,93	2,12	13,40	25,53	0,68
50th-Percentile Queue Length [m/ln]	167,92	23,48	14,73	16,15	102,10	194,55	5,18
95th-Percentile Queue Length [veh/ln]	29,74	5,55	3,48	3,82	19,40	33,82	1,22
95th-Percentile Queue Length [m/ln]	226,58	42,26	26,51	29,08	147,84	257,70	9,33

Movement, Approach, & Intersection Results

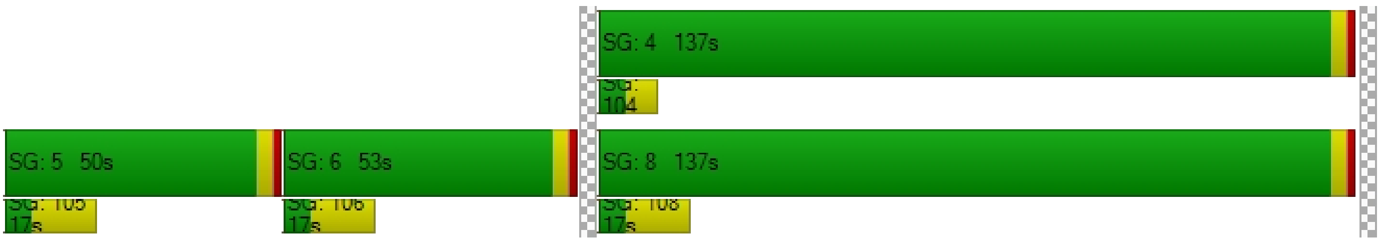
d_M, Delay for Movement [s/veh]	134,05	134,05	134,05	83,28	0,00	80,99	25,39	32,16	0,00	0,00	40,43	42,06
Movement LOS	F	F	F	F		F	C	C			D	D
d_A, Approach Delay [s/veh]	134,05			82,38			31,06			40,47		
Approach LOS	F			F			C			D		
d_I, Intersection Delay [s/veh]	59,36											
Intersection LOS	E											
Intersection V/C	0,589											

Other Modes

g_Walk,mi, Effective Walk Time [s]	9,0	9,0	9,0	9,0
M_corner, Corner Circulation Area [m²/ped]	0,00	0,00	0,00	0,00
M_CW, Crosswalk Circulation Area [m²/ped]	0,00	0,00	0,00	0,00
d_p, Pedestrian Delay [s]	111,17	111,17	111,17	111,17
I_p,int, Pedestrian LOS Score for Intersection	2,054	2,304	2,759	2,783
Crosswalk LOS	B	B	C	C
s_b, Saturation Flow Rate of the bicycle lane	2000	2000	2000	2000
c_b, Capacity of the bicycle lane [bicycles/h]	408	383	1108	1108
d_b, Bicycle Delay [s]	76,00	78,41	23,85	23,85
I_b,int, Bicycle LOS Score for Intersection	2,055	1,670	2,310	2,578
Bicycle LOS	B	A	B	B

Sequence

Ring 1	-	-	-	4	-	-	-	-	-	-	-	-	-	-	-	-
Ring 2	5	6	-	8	-	-	-	-	-	-	-	-	-	-	-	-
Ring 3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Ring 4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-



Intersection Level Of Service Report
Intersection 7: Bester St/ Henshall St.

Control Type:	Signalized	Delay (sec / veh):	63,6
Analysis Method:	HCM 6th Edition	Level Of Service:	E
Analysis Period:	15 minutes	Volume to Capacity (v/c):	0,912

Intersection Setup

Name	Henshall Street			Henshall St.			Bester St.			Bester St.		
Approach	Northbound			Southbound			Eastbound			Westbound		
Lane Configuration												
Turning Movement	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right
Lane Width [m]	3,70	3,70	3,70	3,70	3,70	3,70	3,66	3,66	3,66	3,70	3,70	3,70
No. of Lanes in Entry Pocket	0	0	0	0	0	0	0	0	0	0	0	0
Entry Pocket Length [m]	30,48	30,48	30,48	30,48	30,48	30,48	30,48	30,48	30,48	30,48	30,48	30,48
No. of Lanes in Exit Pocket	0	0	0	1	0	0	0	0	0	0	0	0
Exit Pocket Length [m]	0,00	0,00	0,00	15,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
Speed [km/h]	60,00			60,00			48,28			60,00		
Grade [%]	0,00			0,00			0,00			0,00		
Curb Present	No			No						No		
Crosswalk	Yes			Yes			Yes			Yes		

Volumes

Name	Henshall Street			Henshall St.			Bester St.			Bester St.		
Base Volume Input [veh/h]	196	438	193	438	393	149	0	0	0	218	416	294
Base Volume Adjustment Factor	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000
Heavy Vehicles Percentage [%]	2,00	2,00	2,00	2,00	2,00	2,00	2,00	2,00	2,00	2,00	2,00	2,00
Growth Factor	0,9500	0,9500	0,9500	0,9500	0,9500	0,9500	1,0000	1,0000	1,0000	0,9500	0,9500	0,9500
In-Process Volume [veh/h]	0	0	0	0	0	0	0	0	0	0	0	0
Site-Generated Trips [veh/h]	0	0	0	0	0	0	0	0	0	0	0	0
Diverted Trips [veh/h]	0	0	0	0	0	0	0	0	0	0	0	0
Pass-by Trips [veh/h]	0	0	0	0	0	0	0	0	0	0	0	0
Existing Site Adjustment Volume [veh/h]	0	0	0	0	0	0	0	0	0	0	0	0
Other Volume [veh/h]	0	0	0	0	0	0	0	0	0	0	0	0
Left-Turn on Red Volume [veh/h]	0	0	0	0	0	0	0	0	0	0	0	0
Total Hourly Volume [veh/h]	186	416	183	416	373	142	0	0	0	207	395	279
Peak Hour Factor	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000
Other Adjustment Factor	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000
Total 15-Minute Volume [veh/h]	47	104	46	104	93	36	0	0	0	52	99	70
Total Analysis Volume [veh/h]	186	416	183	416	373	142	0	0	0	207	395	279
Presence of On-Street Parking	No		No	No		No				No		No
On-Street Parking Maneuver Rate [/h]	0	0	0	0	0	0	0	0	0	0	0	0
Local Bus Stopping Rate [/h]	0	0	0	0	0	0	0	0	0	0	0	0
v_do, Outbound Pedestrian Volume crossing	0			0			0			0		
v_di, Inbound Pedestrian Volume crossing m	0			0			0			0		
v_co, Outbound Pedestrian Volume crossing	0			0			0			0		
v_ci, Inbound Pedestrian Volume crossing mi	0			0			0			0		
v_ab, Corner Pedestrian Volume [ped/h]	0			0			0			0		
Bicycle Volume [bicycles/h]	0			0			0			0		

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Version 2021 (SP 0-6)

Intersection Settings

Located in CBD	Yes
Signal Coordination Group	-
Cycle Length [s]	240
Coordination Type	Time of Day Pattern Coordinated
Actuation Type	Fixed time
Offset [s]	0,0
Offset Reference	Lead Green - Beginning of First Green
Permissive Mode	SingleBand
Lost time [s]	0,00

Phasing & Timing

Control Type	Permiss	Permiss	Permiss	Permiss	Permiss	Permiss	Permiss	Permiss	Permiss	Permiss	Permiss	Permiss
Signal Group	0	8	0	0	4	0	0	0	0	0	6	0
Auxiliary Signal Groups												
Lead / Lag	-	-	-	-	-	-	-	-	-	-	-	-
Minimum Green [s]	0	10	0	0	10	0	0	0	0	0	10	0
Maximum Green [s]	0	30	0	0	30	0	0	0	0	0	30	0
Amber [s]	0,0	3,0	0,0	0,0	3,0	0,0	0,0	0,0	0,0	0,0	3,0	0,0
All red [s]	0,0	1,0	0,0	0,0	1,0	0,0	0,0	0,0	0,0	0,0	1,0	0,0
Split [s]	0	155	0	0	155	0	0	0	0	0	85	0
Vehicle Extension [s]	0,0	3,0	0,0	0,0	3,0	0,0	0,0	0,0	0,0	0,0	3,0	0,0
Walk [s]	0	5	0	0	5	0	0	0	0	0	5	0
Pedestrian Clearance [s]	0	6	0	0	9	0	0	0	0	0	12	0
Delayed Vehicle Green [s]	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Rest In Walk		No			No						No	
I1, Start-Up Lost Time [s]	0,0	2,0	0,0	0,0	2,0	0,0	0,0	0,0	0,0	0,0	2,0	0,0
I2, Clearance Lost Time [s]	0,0	2,0	0,0	0,0	2,0	0,0	0,0	0,0	0,0	0,0	2,0	0,0
Minimum Recall		No			No						No	
Maximum Recall		No			No						No	
Pedestrian Recall		No			No						No	
Detector Location [m]	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Detector Length [m]	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
I, Upstream Filtering Factor	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00

Exclusive Pedestrian Phase

Pedestrian Signal Group	0
Pedestrian Walk [s]	0
Pedestrian Clearance [s]	0

Lane Group Calculations

Lane Group	C	C	C	C		C	C
C, Cycle Length [s]	240	240	240	240		240	240
L, Total Lost Time per Cycle [s]	4,00	4,00	4,00	4,00		4,00	4,00
l1_p, Permitted Start-Up Lost Time [s]	0,00	2,00	0,00	2,00		0,00	0,00
l2, Clearance Lost Time [s]	2,00	2,00	2,00	2,00		2,00	2,00
g_i, Effective Green Time [s]	151	151	151	151		81	81
g / C, Green / Cycle	0,63	0,63	0,63	0,63		0,34	0,34
(v / s)_i Volume / Saturation Flow Rate	0,41	0,62	0,46	0,48		0,29	0,29
s, saturation flow rate [veh/h]	1452	294	1373	614		1405	1635
c, Capacity [veh/h]	914	215	864	408		474	552
d1, Uniform Delay [s]	28,18	83,71	30,81	62,68		74,17	74,15
k, delay calibration	0,50	0,50	0,50	0,50		0,50	0,50
I, Upstream Filtering Factor	1,00	1,00	1,00	1,00		1,00	1,00
d2, Incremental Delay [s]	3,71	32,34	5,60	10,36		17,99	15,84
d3, Initial Queue Delay [s]	0,00	0,00	0,00	0,00		0,00	0,00
Rp, platoon ratio	1,00	1,00	1,00	1,00		1,00	1,00
PF, progression factor	1,00	1,00	1,00	1,00		1,00	1,00

Lane Group Results

X, volume / capacity	0,66	0,85	0,74	0,72		0,86	0,86
d, Delay for Lane Group [s/veh]	31,90	116,06	36,42	73,04		92,15	89,99
Lane Group LOS	C	F	D	E		F	F
Critical Lane Group	No	Yes	No	No		Yes	No
50th-Percentile Queue Length [veh/ln]	23,06	13,24	26,96	16,96		25,86	29,73
50th-Percentile Queue Length [m/ln]	175,69	100,90	205,43	129,23		197,07	226,58
95th-Percentile Queue Length [veh/ln]	30,93	19,21	35,47	23,71		34,20	38,68
95th-Percentile Queue Length [m/ln]	235,70	146,37	270,31	180,69		260,62	294,72

Movement, Approach, & Intersection Results

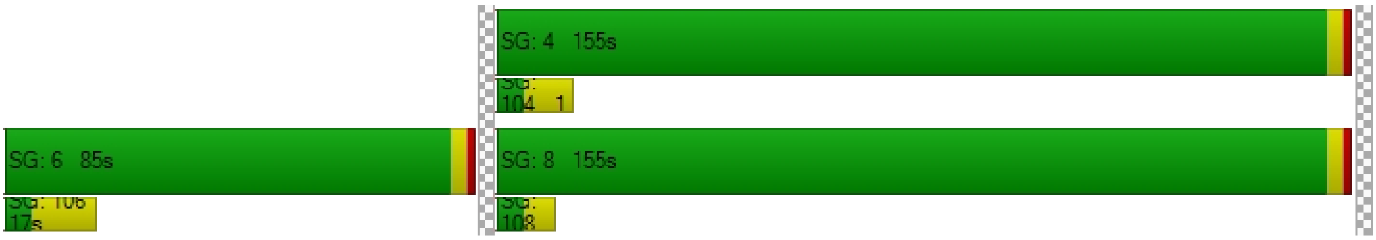
d_M, Delay for Movement [s/veh]	31,90	31,90	116,06	36,42	51,26	73,04	0,00	0,00	0,00	92,15	91,09	89,99
Movement LOS	C	C	F	D	D	E				F	F	F
d_A, Approach Delay [s/veh]		51,52			47,95			0,00			90,99	
Approach LOS		D			D			A			F	
d_I, Intersection Delay [s/veh]	63,63											
Intersection LOS	E											
Intersection V/C	0,912											

Other Modes

g_Walk,mi, Effective Walk Time [s]	9,0	9,0	9,0	9,0
M_corner, Corner Circulation Area [m²/ped]	0,00	0,00	0,00	0,00
M_CW, Crosswalk Circulation Area [m²/ped]	0,00	0,00	0,00	0,00
d_p, Pedestrian Delay [s]	111,17	111,17	111,17	111,17
I_p,int, Pedestrian LOS Score for Intersection	2,843	2,970	2,530	3,159
Crosswalk LOS	C	C	B	C
s_b, Saturation Flow Rate of the bicycle lane	2000	2000	2000	2000
c_b, Capacity of the bicycle lane [bicycles/h]	1258	1258	0	675
d_b, Bicycle Delay [s]	16,50	16,50	120,00	52,67
I_b,int, Bicycle LOS Score for Intersection	2,207	2,328	4,132	2,286
Bicycle LOS	B	B	D	B

Sequence

Ring 1	-	-	-	4	-	-	-	-	-	-	-	-	-	-	-	-
Ring 2	-	6	-	8	-	-	-	-	-	-	-	-	-	-	-	-
Ring 3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Ring 4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-



Intersection Level Of Service Report
Intersection 8: Samora Machel Dr/ Henshall St.

Control Type:	Signalized	Delay (sec / veh):	123,3
Analysis Method:	HCM 6th Edition	Level Of Service:	F
Analysis Period:	15 minutes	Volume to Capacity (v/c):	1,110

Intersection Setup

Name	Henshall Street			Henshall Street			Samora Machel Dr.			Samora Machel Dr.		
Approach	Northbound			Southbound			Eastbound			Westbound		
Lane Configuration												
Turning Movement	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right
Lane Width [m]	3,66	3,70	3,70	3,70	3,70	3,66	3,70	3,70	3,70	3,66	3,66	3,66
No. of Lanes in Entry Pocket	0	0	0	0	0	0	1	0	1	0	0	0
Entry Pocket Length [m]	30,48	30,48	30,48	30,48	30,48	30,48	100,00	30,48	100,00	30,48	30,48	30,48
No. of Lanes in Exit Pocket	0	0	0	0	0	0	0	0	0	0	0	0
Exit Pocket Length [m]	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
Speed [km/h]	48,28			60,00			60,00			48,28		
Grade [%]	0,00			0,00			0,00			0,00		
Curb Present	No			No			No					
Crosswalk	Yes			Yes			Yes			Yes		

Volumes

Name	Henshall Street			Henshall Street			Samora Machel Dr.			Samora Machel Dr.		
Base Volume Input [veh/h]	0	508	311	534	405	0	292	1557	290	0	0	0
Base Volume Adjustment Factor	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000
Heavy Vehicles Percentage [%]	2,00	2,00	2,00	2,00	2,00	2,00	2,00	2,00	2,00	2,00	2,00	2,00
Growth Factor	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000
In-Process Volume [veh/h]	0	0	0	0	0	0	0	0	0	0	0	0
Site-Generated Trips [veh/h]	0	0	0	0	0	0	0	0	0	0	0	0
Diverted Trips [veh/h]	0	0	0	0	0	0	0	0	0	0	0	0
Pass-by Trips [veh/h]	0	0	0	0	0	0	0	0	0	0	0	0
Existing Site Adjustment Volume [veh/h]	0	0	0	0	0	0	0	0	0	0	0	0
Other Volume [veh/h]	0	0	0	0	0	0	0	0	0	0	0	0
Left-Turn on Red Volume [veh/h]	0	0	0	0	0	0	0	0	0	0	0	0
Total Hourly Volume [veh/h]	0	508	311	534	405	0	292	1557	290	0	0	0
Peak Hour Factor	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000
Other Adjustment Factor	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000
Total 15-Minute Volume [veh/h]	0	127	78	134	101	0	73	389	73	0	0	0
Total Analysis Volume [veh/h]	0	508	311	534	405	0	292	1557	290	0	0	0
Presence of On-Street Parking	No		No	No		No	No		No			
On-Street Parking Maneuver Rate [/h]	0	0	0	0	0	0	0	0	0	0	0	0
Local Bus Stopping Rate [/h]	0	0	0	0	0	0	0	0	0	0	0	0
v_do, Outbound Pedestrian Volume crossing		0			0			0			0	
v_di, Inbound Pedestrian Volume crossing m		0			0			0			0	
v_co, Outbound Pedestrian Volume crossing		0			0			0			0	
v_ci, Inbound Pedestrian Volume crossing mi		0			0			0			0	
v_ab, Corner Pedestrian Volume [ped/h]		0			0			0			0	
Bicycle Volume [bicycles/h]		0			0			0			0	

Intersection Settings

Located in CBD	Yes
Signal Coordination Group	-
Cycle Length [s]	240
Coordination Type	Time of Day Pattern Coordinated
Actuation Type	Fixed time
Offset [s]	0,0
Offset Reference	Lead Green - Beginning of First Green
Permissive Mode	SingleBand
Lost time [s]	0,00

Phasing & Timing

Control Type	Permiss	Permiss	Permiss	Permiss	Permiss	Permiss	Permiss	Permiss	Permiss	Permiss	Permiss	Permiss
Signal Group	0	6	0	0	2	0	0	8	0	0	0	0
Auxiliary Signal Groups												
Lead / Lag	-	-	-	-	-	-	-	-	-	-	-	-
Minimum Green [s]	0	10	0	0	10	0	0	10	0	0	0	0
Maximum Green [s]	0	30	0	0	30	0	0	30	0	0	0	0
Amber [s]	0,0	3,0	0,0	0,0	3,0	0,0	0,0	3,0	0,0	0,0	0,0	0,0
All red [s]	0,0	1,0	0,0	0,0	1,0	0,0	0,0	1,0	0,0	0,0	0,0	0,0
Split [s]	0	171	0	0	171	0	0	69	0	0	0	0
Vehicle Extension [s]	0,0	3,0	0,0	0,0	3,0	0,0	0,0	3,0	0,0	0,0	0,0	0,0
Walk [s]	0	5	0	0	5	0	0	5	0	0	0	0
Pedestrian Clearance [s]	0	22	0	0	12	0	0	12	0	0	0	0
Delayed Vehicle Green [s]	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Rest In Walk		No			No			No				
I1, Start-Up Lost Time [s]	0,0	2,0	0,0	0,0	2,0	0,0	0,0	2,0	0,0	0,0	0,0	0,0
I2, Clearance Lost Time [s]	0,0	2,0	0,0	0,0	2,0	0,0	0,0	2,0	0,0	0,0	0,0	0,0
Minimum Recall		No			No			No				
Maximum Recall		No			No			No				
Pedestrian Recall		No			No			No				
Detector Location [m]	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Detector Length [m]	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
I, Upstream Filtering Factor	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00

Exclusive Pedestrian Phase

Pedestrian Signal Group	0
Pedestrian Walk [s]	0
Pedestrian Clearance [s]	0

Lane Group Calculations

Lane Group	C	L	C	L	C	R	
C, Cycle Length [s]	240	240	240	240	240	240	
L, Total Lost Time per Cycle [s]	4,00	4,00	4,00	4,00	4,00	4,00	
l1_p, Permitted Start-Up Lost Time [s]	2,00	0,00	0,00	0,00	0,00	0,00	
l2, Clearance Lost Time [s]	2,00	2,00	2,00	2,00	2,00	2,00	
g_i, Effective Green Time [s]	167	167	167	65	65	65	
g / C, Green / Cycle	0,70	0,70	0,70	0,27	0,27	0,27	
(v / s)_i Volume / Saturation Flow Rate	0,77	0,37	0,24	0,20	0,34	0,18	
s, saturation flow rate [veh/h]	1063	1431	1683	1431	4584	1603	
c, Capacity [veh/h]	760	995	1171	387	1242	434	
d1, Uniform Delay [s]	51,00	17,71	14,62	80,17	87,50	77,90	
k, delay calibration	0,50	0,50	0,50	0,50	0,50	0,50	
I, Upstream Filtering Factor	1,00	1,00	1,00	1,00	1,00	1,00	
d2, Incremental Delay [s]	55,38	2,07	0,81	12,75	121,06	7,92	
d3, Initial Queue Delay [s]	0,00	0,00	0,00	0,00	0,00	0,00	
Rp, platoon ratio	1,00	1,00	1,00	1,00	1,00	1,00	
PF, progression factor	1,00	1,00	1,00	1,00	1,00	1,00	

Lane Group Results

X, volume / capacity	1,08	0,54	0,35	0,75	1,25	0,67	
d, Delay for Lane Group [s/veh]	106,38	19,79	15,43	92,91	208,56	85,82	
Lane Group LOS	F	B	B	F	F	F	
Critical Lane Group	Yes	No	No	No	Yes	No	
50th-Percentile Queue Length [veh/ln]	58,94	15,11	9,36	18,03	39,68	17,03	
50th-Percentile Queue Length [m/ln]	449,12	115,15	71,36	137,37	302,40	129,76	
95th-Percentile Queue Length [veh/ln]	76,57	21,49	14,38	24,99	56,96	23,80	
95th-Percentile Queue Length [m/ln]	583,50	163,74	109,60	190,43	434,01	181,33	

Movement, Approach, & Intersection Results

d_M, Delay for Movement [s/veh]	0,00	106,38	106,38	19,79	15,43	0,00	92,91	208,56	85,82	0,00	0,00	0,00
Movement LOS		F	F	B	B		F	F	F			
d_A, Approach Delay [s/veh]		106,38			17,91			176,13			0,00	
Approach LOS		F			B			F			A	
d_I, Intersection Delay [s/veh]	123,35											
Intersection LOS	F											
Intersection V/C	1,110											

Other Modes

g_Walk,mi, Effective Walk Time [s]	9,0	9,0	9,0	9,0
M_corner, Corner Circulation Area [m²/ped]	0,00	0,00	0,00	0,00
M_CW, Crosswalk Circulation Area [m²/ped]	0,00	0,00	0,00	0,00
d_p, Pedestrian Delay [s]	111,17	111,17	111,17	111,17
I_p,int, Pedestrian LOS Score for Intersection	2,778	3,025	3,236	3,562
Crosswalk LOS	C	C	C	D
s_b, Saturation Flow Rate of the bicycle lane	2000	2000	2000	2000
c_b, Capacity of the bicycle lane [bicycles/h]	1392	1392	542	0
d_b, Bicycle Delay [s]	11,10	11,10	63,80	120,00
I_b,int, Bicycle LOS Score for Intersection	2,911	3,109	2,736	4,132
Bicycle LOS	C	C	B	D

Sequence

Ring 1	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Ring 2	-	6	-	8	-	-	-	-	-	-	-	-	-	-	-	-
Ring 3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Ring 4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Intersection Level Of Service Report
Intersection 9: Bell St./Henshall St.

Control Type:	Signalized	Delay (sec / veh):	151,0
Analysis Method:	HCM 6th Edition	Level Of Service:	F
Analysis Period:	15 minutes	Volume to Capacity (v/c):	1,472

Intersection Setup

Name	Henshall St.			Henshall Street			Bell St.			Bell St.		
Approach	Northbound			Southbound			Eastbound			Westbound		
Lane Configuration												
Turning Movement	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right
Lane Width [m]	3,70	3,70	3,66	3,66	3,70	3,70	3,66	3,66	3,66	3,70	3,70	3,70
No. of Lanes in Entry Pocket	0	0	0	0	0	0	0	0	0	0	0	1
Entry Pocket Length [m]	30,48	30,48	30,48	30,48	30,48	30,48	30,48	30,48	30,48	30,48	30,48	30,48
No. of Lanes in Exit Pocket	0	0	0	0	0	0	0	0	0	0	0	0
Exit Pocket Length [m]	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
Speed [km/h]	60,00			60,00			48,28			60,00		
Grade [%]	0,00			0,00			0,00			0,00		
Curb Present	No			No						No		
Crosswalk	Yes			Yes			Yes			Yes		

Volumes

Name	Henshall St.			Henshall Street			Bell St.			Bell St.		
Base Volume Input [veh/h]	268	433	0	0	421	254	0	0	0	311	1153	351
Base Volume Adjustment Factor	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000
Heavy Vehicles Percentage [%]	2,00	2,00	2,00	2,00	2,00	2,00	2,00	2,00	2,00	2,00	2,00	2,00
Growth Factor	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000
In-Process Volume [veh/h]	0	0	0	0	0	0	0	0	0	0	0	0
Site-Generated Trips [veh/h]	0	0	0	0	0	0	0	0	0	0	0	0
Diverted Trips [veh/h]	0	0	0	0	0	0	0	0	0	0	0	0
Pass-by Trips [veh/h]	0	0	0	0	0	0	0	0	0	0	0	0
Existing Site Adjustment Volume [veh/h]	0	0	0	0	0	0	0	0	0	0	0	0
Other Volume [veh/h]	0	0	0	0	0	0	0	0	0	0	0	0
Left-Turn on Red Volume [veh/h]	0	0	0	0	0	0	0	0	0	0	0	0
Total Hourly Volume [veh/h]	268	433	0	0	421	254	0	0	0	311	1153	351
Peak Hour Factor	0,9500	0,9500	1,0000	1,0000	0,9500	0,9500	1,0000	1,0000	1,0000	0,9500	0,9500	0,9500
Other Adjustment Factor	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000
Total 15-Minute Volume [veh/h]	71	114	0	0	111	67	0	0	0	82	303	92
Total Analysis Volume [veh/h]	282	456	0	0	443	267	0	0	0	327	1214	369
Presence of On-Street Parking	No		No	No		No				No		No
On-Street Parking Maneuver Rate [/h]	0	0	0	0	0	0	0	0	0	0	0	0
Local Bus Stopping Rate [/h]	0	0	0	0	0	0	0	0	0	0	0	0
v_do, Outbound Pedestrian Volume crossing		0			0			0			0	
v_di, Inbound Pedestrian Volume crossing m		0			0			0			0	
v_co, Outbound Pedestrian Volume crossing		0			0			0			0	
v_ci, Inbound Pedestrian Volume crossing mi		0			0			0			0	
v_ab, Corner Pedestrian Volume [ped/h]		0			0			0			0	
Bicycle Volume [bicycles/h]		0			0			0			0	

Intersection Settings

Located in CBD	Yes
Signal Coordination Group	-
Cycle Length [s]	240
Coordination Type	Time of Day Pattern Coordinated
Actuation Type	Fixed time
Offset [s]	0,0
Offset Reference	Lead Green - Beginning of First Green
Permissive Mode	SingleBand
Lost time [s]	0,00

Phasing & Timing

Control Type	Permiss	Permiss	Permiss	Permiss	Permiss	Permiss	Permiss	Permiss	Permiss	Permiss	Permiss	Permiss
Signal Group	0	6	0	0	2	0	0	0	0	0	4	0
Auxiliary Signal Groups												
Lead / Lag	-	-	-	-	-	-	-	-	-	-	-	-
Minimum Green [s]	0	10	0	0	10	0	0	0	0	0	10	0
Maximum Green [s]	0	30	0	0	30	0	0	0	0	0	30	0
Amber [s]	0,0	3,0	0,0	0,0	3,0	0,0	0,0	0,0	0,0	0,0	3,0	0,0
All red [s]	0,0	1,0	0,0	0,0	1,0	0,0	0,0	0,0	0,0	0,0	1,0	0,0
Split [s]	0	150	0	0	150	0	0	0	0	0	90	0
Vehicle Extension [s]	0,0	3,0	0,0	0,0	3,0	0,0	0,0	0,0	0,0	0,0	3,0	0,0
Walk [s]	0	5	0	0	5	0	0	0	0	0	5	0
Pedestrian Clearance [s]	0	6	0	0	12	0	0	0	0	0	9	0
Delayed Vehicle Green [s]	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Rest In Walk		No			No						No	
I1, Start-Up Lost Time [s]	0,0	2,0	0,0	0,0	2,0	0,0	0,0	0,0	0,0	0,0	2,0	0,0
I2, Clearance Lost Time [s]	0,0	2,0	0,0	0,0	2,0	0,0	0,0	0,0	0,0	0,0	2,0	0,0
Minimum Recall		No			No						No	
Maximum Recall		No			No						No	
Pedestrian Recall		No			No						No	
Detector Location [m]	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Detector Length [m]	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
I, Upstream Filtering Factor	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00

Exclusive Pedestrian Phase

Pedestrian Signal Group	0
Pedestrian Walk [s]	0
Pedestrian Clearance [s]	0

Lane Group Calculations

Lane Group	C	C	C		C	C	R
C, Cycle Length [s]	240	240	240		240	240	240
L, Total Lost Time per Cycle [s]	4,00	4,00	4,00		4,00	4,00	4,00
l1_p, Permitted Start-Up Lost Time [s]	0,00	0,00	2,00		0,00	0,00	0,00
l2, Clearance Lost Time [s]	2,00	2,00	2,00		2,00	2,00	2,00
g_i, Effective Green Time [s]	146	146	146		86	86	86
g / C, Green / Cycle	0,61	0,61	0,61		0,36	0,36	0,36
(v / s)_i Volume / Saturation Flow Rate	0,47	0,29	0,98		0,49	0,46	0,23
s, saturation flow rate [veh/h]	1577	1532	272		1565	1683	1603
c, Capacity [veh/h]	959	932	195		561	603	574
d1, Uniform Delay [s]	34,61	25,90	94,06		77,00	77,00	64,18
k, delay calibration	0,50	0,50	0,50		0,50	0,50	0,50
I, Upstream Filtering Factor	1,00	1,00	1,00		1,00	1,00	1,00
d2, Incremental Delay [s]	5,92	1,74	193,86		177,57	138,89	5,45
d3, Initial Queue Delay [s]	0,00	0,00	0,00		0,00	0,00	0,00
Rp, platoon ratio	1,00	1,00	1,00		1,00	1,00	1,00
PF, progression factor	1,00	1,00	1,00		1,00	1,00	1,00

Lane Group Results

X, volume / capacity	0,77	0,48	1,37		1,37	1,28	0,64
d, Delay for Lane Group [s/veh]	40,53	27,64	287,92		254,57	215,89	69,63
Lane Group LOS	D	C	F		F	F	E
Critical Lane Group	No	No	Yes		Yes	No	No
50th-Percentile Queue Length [veh/ln]	33,35	14,72	22,93		62,26	60,45	19,83
50th-Percentile Queue Length [m/ln]	254,10	112,18	174,72		474,38	460,63	151,14
95th-Percentile Queue Length [veh/ln]	42,82	21,01	37,61		90,87	85,72	27,14
95th-Percentile Queue Length [m/ln]	326,26	160,12	286,56		692,40	653,18	206,79

Movement, Approach, & Intersection Results

d_M, Delay for Movement [s/veh]	40,53	40,53	0,00	0,00	27,64	287,92	0,00	0,00	0,00	254,57	229,95	69,63
Movement LOS	D	D			C	F				F	F	E
d_A, Approach Delay [s/veh]	40,53			125,52			0,00			203,19		
Approach LOS	D			F			A			F		
d_I, Intersection Delay [s/veh]	151,02											
Intersection LOS	F											
Intersection V/C	1,472											

Other Modes

g_Walk,mi, Effective Walk Time [s]	9,0	9,0	9,0	9,0
M_corner, Corner Circulation Area [m²/ped]	0,00	0,00	0,00	0,00
M_CW, Crosswalk Circulation Area [m²/ped]	0,00	0,00	0,00	0,00
d_p, Pedestrian Delay [s]	111,17	111,17	111,17	111,17
I_p,int, Pedestrian LOS Score for Intersection	2,967	2,984	3,524	3,108
Crosswalk LOS	C	C	D	C
s_b, Saturation Flow Rate of the bicycle lane	2000	2000	2000	2000
c_b, Capacity of the bicycle lane [bicycles/h]	1217	1217	0	717
d_b, Bicycle Delay [s]	18,41	18,41	120,00	49,41
I_b,int, Bicycle LOS Score for Intersection	2,777	2,145	4,132	3,135
Bicycle LOS	C	B	D	C

Sequence

Ring 1	-	2	-	4	-	-	-	-	-	-	-	-	-	-	-	-
Ring 2	-	6	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Ring 3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Ring 4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Intersection Level Of Service Report
Intersection 10: Andrew St/ Henshall St

Control Type:	All-way stop	Delay (sec / veh):	14,4
Analysis Method:	HCM 6th Edition	Level Of Service:	B
Analysis Period:	15 minutes	Volume to Capacity (v/c):	0,614

Intersection Setup

Name	Henshall St.		Andrew St.		Andrew St.	
Approach	Northbound		Eastbound		Westbound	
Lane Configuration						
Turning Movement	Left	Right	Thru	Right	Left	Thru
Lane Width [m]	3,70	3,70	3,70	3,70	3,70	3,70
No. of Lanes in Entry Pocket	0	0	0	1	0	0
Entry Pocket Length [m]	30,48	30,48	30,48	300,00	30,48	30,48
No. of Lanes in Exit Pocket	0	0	0	0	0	0
Exit Pocket Length [m]	0,00	0,00	0,00	0,00	0,00	0,00
Speed [km/h]	60,00		48,28		60,00	
Grade [%]	0,00		0,00		0,00	
Crosswalk	Yes		Yes		Yes	

Volumes

Name	Henshall St.		Andrew St.		Andrew St.	
Base Volume Input [veh/h]	396	52	125	298	16	119
Base Volume Adjustment Factor	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000
Heavy Vehicles Percentage [%]	2,00	2,00	2,00	2,00	2,00	2,00
Growth Factor	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000
In-Process Volume [veh/h]	0	0	0	0	0	0
Site-Generated Trips [veh/h]	0	0	0	0	0	0
Diverted Trips [veh/h]	0	0	0	0	0	0
Pass-by Trips [veh/h]	0	0	0	0	0	0
Existing Site Adjustment Volume [veh/h]	0	0	0	0	0	0
Other Volume [veh/h]	0	0	0	0	0	0
Total Hourly Volume [veh/h]	396	52	125	298	16	119
Peak Hour Factor	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000
Other Adjustment Factor	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000
Total 15-Minute Volume [veh/h]	99	13	31	75	4	30
Total Analysis Volume [veh/h]	396	52	125	298	16	119
Pedestrian Volume [ped/h]	0		0		0	

Intersection Settings

Lanes

Capacity per Entry Lane [veh/h]	730	605	558	614
Degree of Utilization, x	0,61	0,21	0,53	0,22

Movement, Approach, & Intersection Results

95th-Percentile Queue Length [veh]	4,25	0,77	3,14	0,83
95th-Percentile Queue Length [m]	32,41	5,88	23,96	6,36
Approach Delay [s/veh]	15,44	14,53		10,51
Approach LOS	C	B		B
Intersection Delay [s/veh]	14,40			
Intersection LOS	B			

Intersection Level Of Service Report
Intersection 11: Old Pretoria Rd/ Madiba Dr

Control Type:	Signalized	Delay (sec / veh):	402,3
Analysis Method:	HCM 6th Edition	Level Of Service:	F
Analysis Period:	15 minutes	Volume to Capacity (v/c):	3,182

Intersection Setup

Name	Madiba Dr			Madiba Dr			Old Pretoria Rd			Old Pretoria Rd		
Approach	Northbound			Southbound			Eastbound			Westbound		
Lane Configuration												
Turning Movement	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right
Lane Width [m]	3,70	3,70	3,70	3,70	3,70	3,70	3,70	3,70	3,70	3,70	3,70	3,70
No. of Lanes in Entry Pocket	1	0	1	1	0	1	1	0	1	1	0	1
Entry Pocket Length [m]	50,00	30,48	90,00	100,00	30,48	60,00	50,00	30,48	60,00	60,00	30,48	100,00
No. of Lanes in Exit Pocket	0	0	0	0	0	0	0	0	0	0	0	0
Exit Pocket Length [m]	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
Speed [km/h]	60,00			60,00			60,00			60,00		
Grade [%]	0,00			0,00			0,00			0,00		
Curb Present	No			No			No			No		
Crosswalk	Yes			Yes			Yes			Yes		

Volumes

Name	Madiba Dr			Madiba Dr			Old Pretoria Rd			Old Pretoria Rd		
Base Volume Input [veh/h]	340	1576	99	979	3208	766	886	992	560	373	470	934
Base Volume Adjustment Factor	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000
Heavy Vehicles Percentage [%]	2,00	2,00	2,00	2,00	2,00	2,00	2,00	2,00	2,00	2,00	2,00	2,00
Growth Factor	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000
In-Process Volume [veh/h]	0	0	0	0	0	0	0	0	0	0	0	0
Site-Generated Trips [veh/h]	0	0	0	0	0	0	0	0	0	0	0	0
Diverted Trips [veh/h]	0	0	0	0	0	0	0	0	0	0	0	0
Pass-by Trips [veh/h]	0	0	0	0	0	0	0	0	0	0	0	0
Existing Site Adjustment Volume [veh/h]	0	0	0	0	0	0	0	0	0	0	0	0
Other Volume [veh/h]	0	0	0	0	0	0	0	0	0	0	0	0
Left-Turn on Red Volume [veh/h]	0	0	0	0	0	0	0	0	0	0	0	0
Total Hourly Volume [veh/h]	340	1576	99	979	3208	766	886	992	560	373	470	934
Peak Hour Factor	0,9500	0,9500	0,9500	0,9500	0,9500	0,9500	0,9500	0,9500	0,9500	0,9500	0,9500	0,9500
Other Adjustment Factor	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000
Total 15-Minute Volume [veh/h]	89	415	26	258	844	202	233	261	147	98	124	246
Total Analysis Volume [veh/h]	358	1659	104	1031	3377	806	933	1044	589	393	495	983
Presence of On-Street Parking	No		No	No		No	No		No	No		No
On-Street Parking Maneuver Rate [/h]	0	0	0	0	0	0	0	0	0	0	0	0
Local Bus Stopping Rate [/h]	0	0	0	0	0	0	0	0	0	0	0	0
v_do, Outbound Pedestrian Volume crossing	0			0			0			0		
v_di, Inbound Pedestrian Volume crossing m	0			0			0			0		
v_co, Outbound Pedestrian Volume crossing	0			0			0			0		
v_ci, Inbound Pedestrian Volume crossing mi	0			0			0			0		
v_ab, Corner Pedestrian Volume [ped/h]	0			0			0			0		
Bicycle Volume [bicycles/h]	0			0			0			0		

Intersection Settings

Located in CBD	Yes
Signal Coordination Group	-
Cycle Length [s]	90
Coordination Type	Time of Day Pattern Coordinated
Actuation Type	Fixed time
Offset [s]	0,0
Offset Reference	Lead Green - Beginning of First Green
Permissive Mode	SingleBand
Lost time [s]	0,00

Phasing & Timing

Control Type	Permiss	Permiss	Permiss	Permiss	Permiss	Permiss	Permiss	Permiss	Permiss	Permiss	Permiss	Permiss
Signal Group	0	6	0	0	2	0	0	8	0	0	4	0
Auxiliary Signal Groups												
Lead / Lag	-	-	-	-	-	-	-	-	-	-	-	-
Minimum Green [s]	0	10	0	0	10	0	0	10	0	0	10	0
Maximum Green [s]	0	30	0	0	30	0	0	30	0	0	30	0
Amber [s]	0,0	3,0	0,0	0,0	3,0	0,0	0,0	3,0	0,0	0,0	3,0	0,0
All red [s]	0,0	1,0	0,0	0,0	1,0	0,0	0,0	1,0	0,0	0,0	1,0	0,0
Split [s]	0	47	0	0	47	0	0	43	0	0	43	0
Vehicle Extension [s]	0,0	3,0	0,0	0,0	3,0	0,0	0,0	3,0	0,0	0,0	3,0	0,0
Walk [s]	0	5	0	0	5	0	0	5	0	0	5	0
Pedestrian Clearance [s]	0	22	0	0	22	0	0	30	0	0	27	0
Delayed Vehicle Green [s]	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Rest In Walk		No			No			No			No	
I1, Start-Up Lost Time [s]	0,0	2,0	0,0	0,0	2,0	0,0	0,0	2,0	0,0	0,0	2,0	0,0
I2, Clearance Lost Time [s]	0,0	2,0	0,0	0,0	2,0	0,0	0,0	2,0	0,0	0,0	2,0	0,0
Minimum Recall		No			No			No			No	
Maximum Recall		No			No			No			No	
Pedestrian Recall		No			No			No			No	
Detector Location [m]	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Detector Length [m]	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
I, Upstream Filtering Factor	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00

Exclusive Pedestrian Phase

Pedestrian Signal Group	0
Pedestrian Walk [s]	0
Pedestrian Clearance [s]	0

Lane Group Calculations

Lane Group	L	C	R	L	C	R	L	C	R	L	C	R
C, Cycle Length [s]	90	90	90	90	90	90	90	90	90	90	90	90
L, Total Lost Time per Cycle [s]	4,00	4,00	4,00	4,00	4,00	4,00	4,00	4,00	4,00	4,00	4,00	4,00
l1_p, Permitted Start-Up Lost Time [s]	0,00	0,00	2,00	0,00	0,00	2,00	0,00	0,00	2,00	0,00	0,00	2,00
l2, Clearance Lost Time [s]	2,00	2,00	2,00	2,00	2,00	2,00	2,00	2,00	2,00	2,00	2,00	2,00
g_i, Effective Green Time [s]	43	43	43	43	43	43	39	39	39	39	39	39
g / C, Green / Cycle	0,48	0,48	0,48	0,48	0,48	0,48	0,43	0,43	0,43	0,43	0,43	0,43
(v / s)_i Volume / Saturation Flow Rate	0,25	0,36	2,14	0,72	0,74	1,54	0,65	0,33	0,37	0,27	0,15	1,04
s, saturation flow rate [veh/h]	1431	4584	49	1431	4584	524	1431	3204	1577	1431	3204	944
c, Capacity [veh/h]	683	2190	80	683	2190	164	620	1389	565	620	1389	210
d1, Uniform Delay [s]	16,37	19,23	45,00	23,50	23,50	41,33	25,50	21,43	33,12	19,92	17,09	41,18
k, delay calibration	0,50	0,50	0,50	0,50	0,50	0,50	0,50	0,50	0,50	0,50	0,50	0,50
I, Upstream Filtering Factor	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00
d2, Incremental Delay [s]	2,86	2,51	200,61	236,37	246,11	1780,60	235,63	3,80	49,42	4,88	0,72	1670,92
d3, Initial Queue Delay [s]	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
Rp, platoon ratio	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00
PF, progression factor	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00

Lane Group Results

X, volume / capacity	0,52	0,76	1,30	1,51	1,54	4,93	1,51	0,75	1,04	0,63	0,36	4,69
d, Delay for Lane Group [s/veh]	19,23	21,74	245,61	259,87	269,61	1821,94	261,13	25,23	82,53	24,81	17,81	1712,10
Lane Group LOS	B	C	F	F	F	F	F	C	F	C	B	F
Critical Lane Group	No	No	Yes	No	No	No	No	No	No	No	No	Yes
50th-Percentile Queue Length [veh/ln]	5,24	9,04	6,20	57,76	63,67	42,24	52,56	9,21	10,03	6,78	3,34	50,93
50th-Percentile Queue Length [m/ln]	39,94	68,86	47,25	440,10	485,19	321,89	400,48	70,20	76,44	51,63	25,48	388,12
95th-Percentile Queue Length [veh/ln]	9,00	13,97	11,16	89,74	99,06	75,26	81,58	14,19	15,65	11,04	6,02	88,74
95th-Percentile Queue Length [m/ln]	68,55	106,43	85,05	683,82	754,87	573,49	621,63	108,13	119,22	84,16	45,87	676,17

Movement, Approach, & Intersection Results

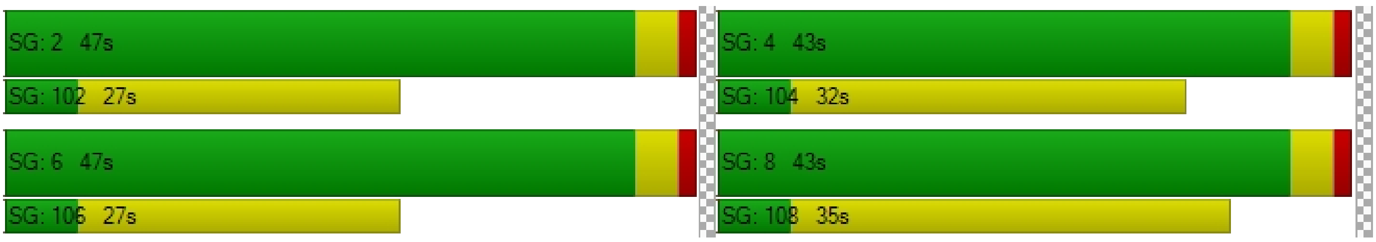
d_M, Delay for Movement [s/veh]	19,23	21,74	245,61	259,87	269,61	1821,94	261,13	25,23	82,53	24,81	17,81	1712,10
Movement LOS	B	C	F	F	F	F	F	C	F	C	B	F
d_A, Approach Delay [s/veh]	32,29			507,65			124,16			909,44		
Approach LOS	C			F			F			F		
d_I, Intersection Delay [s/veh]	402,27											
Intersection LOS	F											
Intersection V/C	3,182											

Other Modes

g_Walk,mi, Effective Walk Time [s]	9,0	9,0	9,0	9,0
M_corner, Corner Circulation Area [m²/ped]	0,00	0,00	0,00	0,00
M_CW, Crosswalk Circulation Area [m²/ped]	0,00	0,00	0,00	0,00
d_p, Pedestrian Delay [s]	36,45	36,45	36,45	36,45
I_p,int, Pedestrian LOS Score for Intersection	5,144	6,153	4,919	3,872
Crosswalk LOS	F	F	E	D
s_b, Saturation Flow Rate of the bicycle lane	2000	2000	2000	2000
c_b, Capacity of the bicycle lane [bicycles/h]	956	956	867	867
d_b, Bicycle Delay [s]	12,27	12,27	14,45	14,45
I_b,int, Bicycle LOS Score for Intersection	2,726	4,427	3,677	3,103
Bicycle LOS	B	E	D	C

Sequence

Ring 1	-	2	-	4	-	-	-	-	-	-	-	-	-	-	-	-
Ring 2	-	6	-	8	-	-	-	-	-	-	-	-	-	-	-	-
Ring 3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Ring 4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-



Intersection Level Of Service Report
Intersection 12: Andrew St/ Paul Kruger St

Control Type:	Two-way stop	Delay (sec / veh):	338,3
Analysis Method:	HCM 6th Edition	Level Of Service:	F
Analysis Period:	15 minutes	Volume to Capacity (v/c):	0,507

Intersection Setup

Name	Paul Kruger St.		Old Pretoria Rd		Andrew St.	
Approach	Northbound		Eastbound		Westbound	
Lane Configuration						
Turning Movement	Left	Right	Thru	Right	Left	Thru
Lane Width [m]	3,70	3,70	3,70	3,70	3,70	3,70
No. of Lanes in Entry Pocket	1	0	0	0	0	0
Entry Pocket Length [m]	200,00	30,48	30,48	30,48	30,48	30,48
No. of Lanes in Exit Pocket	0	0	0	0	1	0
Exit Pocket Length [m]	0,00	0,00	0,00	0,00	15,00	0,00
Speed [km/h]	60,00		60,00		60,00	
Grade [%]	0,00		0,00		0,00	
Crosswalk	Yes		Yes		Yes	

Volumes

Name	Paul Kruger St.		Old Pretoria Rd		Andrew St.	
Base Volume Input [veh/h]	476	7	840	347	50	869
Base Volume Adjustment Factor	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000
Heavy Vehicles Percentage [%]	2,00	2,00	2,00	2,00	2,00	2,00
Growth Factor	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000
In-Process Volume [veh/h]	0	0	0	0	0	0
Site-Generated Trips [veh/h]	0	0	0	0	0	0
Diverted Trips [veh/h]	0	0	0	0	0	0
Pass-by Trips [veh/h]	0	0	0	0	0	0
Existing Site Adjustment Volume [veh/h]	0	0	0	0	0	0
Other Volume [veh/h]	0	0	0	0	0	0
Total Hourly Volume [veh/h]	476	7	840	347	50	869
Peak Hour Factor	0,9500	0,9500	0,9500	0,9500	0,9500	0,9500
Other Adjustment Factor	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000
Total 15-Minute Volume [veh/h]	125	2	221	91	13	229
Total Analysis Volume [veh/h]	501	7	884	365	53	915
Pedestrian Volume [ped/h]	0		0		0	

Intersection Settings

Priority Scheme	Stop	Free	Free
Flared Lane			
Storage Area [veh]	0	0	0
Two-Stage Gap Acceptance	No		
Number of Storage Spaces in Median	0	0	0

Movement, Approach, & Intersection Results

V/C, Movement V/C Ratio	0,95	0,51	0,01	0,52	0,00	0,01
d_M, Delay for Movement [s/veh]	50,58	338,32	0,00	15,38	0,00	0,00
Movement LOS	F	F	A	C	A	A
95th-Percentile Queue Length [veh/ln]	5,97	9,35	1,49	2,99	0,00	0,00
95th-Percentile Queue Length [m/ln]	45,47	71,28	11,39	22,78	0,00	0,00
d_A, Approach Delay [s/veh]	54,54		4,50		0,00	
Approach LOS	F		A		A	
d_I, Intersection Delay [s/veh]	12,23					
Intersection LOS	F					

Vistro File: \...\Analysis of intersections in Mbombela.vistro
Report File: N:\...\3. 2021 PM Peak (with taxis).pdf

Scenario 3 2021 PM Peak (with taxis)
2021/11/02

Turning Movement Volume: Summary

ID	Intersection Name	Northbound		Southbound		Westbound		Total Volume
		Left	Right	Thru	Right	Left	Thru	
1	D2296/ Friedenheim Rd	254	112	473	66	1070	699	2674

ID	Intersection Name	Northbound			Southbound			Eastbound			Westbound			Total Volume
		Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	
3	Kragbron Rd/ Timerhout St	95	163	6	19	79	525	525	9	202	14	14	9	1660

ID	Intersection Name	Northbound			Southbound		Eastbound		Westbound		Total Volume
		Left	Thru	Right	Left	Right	Left	Thru	Thru	Right	
6	Bester St/ Corrier St	104	24	172	56	36	74	381	599	18	1464

ID	Intersection Name	Northbound			Southbound			Westbound			Total Volume
		Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	
7	Bester St/ Henshall St.	186	416	183	416	373	142	207	395	279	2597

ID	Intersection Name	Northbound		Southbound		Eastbound			Total Volume
		Thru	Right	Left	Thru	Left	Thru	Right	
8	Samora Machel Dr/ Henshall St.	508	311	534	405	292	1557	290	3897

ID	Intersection Name	Northbound		Southbound		Westbound			Total Volume
		Left	Thru	Thru	Right	Left	Thru	Right	
9	Bell St./Henshall St.	268	433	421	254	311	1153	351	3191

ID	Intersection Name	Northbound		Eastbound		Westbound		Total Volume
		Left	Right	Thru	Right	Left	Thru	
10	Andrew St/ Henshall St	396	52	125	298	16	119	1006

ID	Intersection Name	Northbound			Southbound			Eastbound			Westbound			Total Volume
		Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	
11	Old Pretoria Rd/ Madiba Dr	340	1576	99	979	3208	766	886	992	560	373	470	934	11183

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ID	Intersection Name	Northbound		Eastbound		Westbound		Total Volume
		Left	Right	Thru	Right	Left	Thru	
12	Andrew St/ Paul Kruger St	476	7	840	347	50	869	2589

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Report File: N:\...\3. 2021 PM Peak (with taxis).pdf — 2021/11/02

Turning Movement Volume: Detail

ID	Intersection Name	Volume Type	Northbound		Southbound		Westbound		Total Volume
			Left	Right	Thru	Right	Left	Thru	
1	D2296/ Friedenheim Rd	Final Base	254	112	473	66	1070	699	2674
		Growth Factor	1,00	1,00	1,00	1,00	1,00	1,00	-
		In Process	0	0	0	0	0	0	0
		Net New Trips	0	0	0	0	0	0	0
		Other	0	0	0	0	0	0	0
		Future Total	**254**	**112**	**473**	**66**	**1070**	**699**	**2674**

ID	Intersection Name	Volume Type	Northbound			Southbound			Eastbound			Westbound			Total Volume
			Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	
3	Kragbron Rd/ Timerhout St	Final Base	95	163	6	19	79	525	525	9	202	14	14	9	1660
		Growth Factor	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	-
		In Process	0	0	0	0	0	0	0	0	0	0	0	0	0
		Net New Trips	0	0	0	0	0	0	0	0	0	0	0	0	0
		Other	0	0	0	0	0	0	0	0	0	0	0	0	0
		Future Total	**95**	**163**	**6**	**19**	**79**	**525**	**525**	**9**	**202**	**14**	**14**	**9**	**1660**

ID	Intersection Name	Volume Type	Northbound			Southbound		Eastbound		Westbound		Total Volume
			Left	Thru	Right	Left	Right	Left	Thru	Thru	Right	
6	Bester St/ Corrier St	Final Base	109	25	181	59	38	78	401	631	19	1541
		Growth Factor	0,95	0,95	0,95	0,95	0,95	0,95	0,95	0,95	0,95	-
		In Process	0	0	0	0	0	0	0	0	0	0
		Net New Trips	0	0	0	0	0	0	0	0	0	0
		Other	0	0	0	0	0	0	0	0	0	0
		Future Total	**104**	**24**	**172**	**56**	**36**	**74**	**381**	**599**	**18**	**1464**

ID	Intersection Name	Volume Type	Northbound			Southbound			Westbound			Total Volume
			Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	
7	Bester St/ Henshall St.	Final Base	196	438	193	438	393	149	218	416	294	2735
		Growth Factor	0,95	0,95	0,95	0,95	0,95	0,95	0,95	0,95	0,95	-
		In Process	0	0	0	0	0	0	0	0	0	0
		Net New Trips	0	0	0	0	0	0	0	0	0	0
		Other	0	0	0	0	0	0	0	0	0	0
		Future Total	**186**	**416**	**183**	**416**	**373**	**142**	**207**	**395**	**279**	**2597**

ID	Intersection Name	Volume Type	Northbound		Southbound		Eastbound			Total Volume
			Thru	Right	Left	Thru	Left	Thru	Right	
8	Samora Machel Dr/ Henshall St.	Final Base	508	311	534	405	292	1557	290	3897
		Growth Factor	1,00	1,00	1,00	1,00	1,00	1,00	1,00	-
		In Process	0	0	0	0	0	0	0	0
		Net New Trips	0	0	0	0	0	0	0	0
		Other	0	0	0	0	0	0	0	0
		Future Total	**508**	**311**	**534**	**405**	**292**	**1557**	**290**	**3897**

ID	Intersection Name	Volume Type	Northbound		Southbound		Westbound			Total Volume
			Left	Thru	Thru	Right	Left	Thru	Right	
9	Bell St./Henshall St.	Final Base	268	433	421	254	311	1153	351	3191
		Growth Factor	1,00	1,00	1,00	1,00	1,00	1,00	1,00	-
		In Process	0	0	0	0	0	0	0	0
		Net New Trips	0	0	0	0	0	0	0	0
		Other	0	0	0	0	0	0	0	0
		Future Total	**268**	**433**	**421**	**254**	**311**	**1153**	**351**	**3191**

ID	Intersection Name	Volume Type	Northbound		Eastbound		Westbound		Total Volume
			Left	Right	Thru	Right	Left	Thru	
10	Andrew St/ Henshall St	Final Base	396	52	125	298	16	119	1006
		Growth Factor	1,00	1,00	1,00	1,00	1,00	1,00	-
		In Process	0	0	0	0	0	0	0
		Net New Trips	0	0	0	0	0	0	0
		Other	0	0	0	0	0	0	0
		Future Total	**396**	**52**	**125**	**298**	**16**	**119**	**1006**

ID	Intersection Name	Volume Type	Northbound			Southbound			Eastbound			Westbound			Total Volume
			Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	
11	Old Pretoria Rd/ Madiba Dr	Final Base	340	1576	99	979	3208	766	886	992	560	373	470	934	11183
		Growth Factor	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	-
		In Process	0	0	0	0	0	0	0	0	0	0	0	0	0
		Net New Trips	0	0	0	0	0	0	0	0	0	0	0	0	0
		Other	0	0	0	0	0	0	0	0	0	0	0	0	0
		Future Total	**340**	**1576**	**99**	**979**	**3208**	**766**	**886**	**992**	**560**	**373**	**470**	**934**	**11183**

ID	Intersection Name	Volume Type	Northbound		Eastbound		Westbound		Total Volume
			Left	Right	Thru	Right	Left	Thru	
12	Andrew St/ Paul Kruger St	Final Base	476	7	840	347	50	869	2589
		Growth Factor	1,00	1,00	1,00	1,00	1,00	1,00	-
		In Process	0	0	0	0	0	0	0
		Net New Trips	0	0	0	0	0	0	0
		Other	0	0	0	0	0	0	0
		Future Total	**476**	**7**	**840**	**347**	**50**	**869**	**2589**

Signal Warrants Report For Intersection 3: Kragbron Rd/ Timerhout St

Warrants Summary

Warrant	Name	Met?
#1	Eight Hour Vehicular Volume	Yes
#2	Four Hour Vehicular Volume	Yes
#3	Peak Hour	Yes

Intersection Warrants Parameters

Major Approaches	S, N
Minor Approaches	E, W
Speed > 40mph	Yes
Population < 10,000	No
Warrant Factor	70%

Warrant Analysis Traffic Volumes

Hour	Major Streets		Minor Streets	
	S	N	E	W
1	264	623	37	736
2	256	604	36	714
3	251	592	35	699
4	235	554	33	655
5	209	492	29	581
6	206	486	29	574
7	203	480	28	567
8	185	436	26	515
9	182	430	26	508
10	180	424	25	500
11	156	368	22	434
12	145	343	20	405
13	143	336	20	397
14	106	249	15	294
15	106	249	15	294
16	74	174	10	206
17	42	100	6	118
18	42	100	6	118
19	24	56	3	66
20	13	31	2	37
21	8	19	1	22
22	3	6	0	7
23	3	6	0	7
24	3	6	0	7

Warrant Analysis by Hour

Hour	Major Streets		Minor Street		Warrant 1 Condition A				Warrant 1 Condition B				Warrant 2	Warrant 3
	Number	Volume	Number	Volume	100%	80%	70%	56%	100%	80%	70%	56%		Condition B
1	2	887	2	736	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes
2	2	860	2	714	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes
3	2	843	2	699	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes
4	2	789	2	655	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes
5	2	701	2	581	Yes	Yes	Yes	Yes	No	No	Yes	Yes	Yes	Yes
6	2	692	2	574	Yes	Yes	Yes	Yes	No	No	Yes	Yes	Yes	Yes
7	2	683	2	567	Yes	Yes	Yes	Yes	No	No	Yes	Yes	Yes	Yes
8	2	621	2	515	Yes	Yes	Yes	Yes	No	No	No	Yes	Yes	Yes
9	2	612	2	508	Yes	Yes	Yes	Yes	No	No	No	Yes	Yes	Yes
10	2	604	2	500	Yes	Yes	Yes	Yes	No	No	No	Yes	Yes	Yes
11	2	524	2	434	No	Yes	Yes	Yes	No	No	No	Yes	Yes	Yes
12	2	488	2	405	No	Yes	Yes	Yes	No	No	No	No	Yes	Yes
13	2	479	2	397	No	No	Yes	Yes	No	No	No	No	Yes	Yes
14	2	355	2	294	No	No	No	Yes	No	No	No	No	Yes	No
15	2	355	2	294	No	No	No	Yes	No	No	No	No	Yes	No
16	2	248	2	206	No	No	No	No	No	No	No	No	No	No
17	2	142	2	118	No	No	No	No	No	No	No	No	No	No
18	2	142	2	118	No	No	No	No	No	No	No	No	No	No
19	2	80	2	66	No	No	No	No	No	No	No	No	No	No
20	2	44	2	37	No	No	No	No	No	No	No	No	No	No
21	2	27	2	22	No	No	No	No	No	No	No	No	No	No
22	2	9	2	7	No	No	No	No	No	No	No	No	No	No
23	2	9	2	7	No	No	No	No	No	No	No	No	No	No
24	2	9	2	7	No	No	No	No	No	No	No	No	No	No
Hours Met					10	12	13	15	0	4	7	11	15	13

Warrant 3 Condition A

Orientation	E	W
Total Stopped Delay Per Vehicle on Minor Approach (s)	12,6	41,7
Number of Lanes on Minor Street Approach	1	2
VehicleHours of Stopped Delay on Minor Approach ([h]h:mm)	0:07	8:31
Delay Condition Met	No	Yes
Volume on Minor Street Approach During Same Hour	37	736
High Minor Volume Condition Met	No	Yes
Total Entering Volume on All Approaches During Same Hour	1660	1660
Number of Approaches on Intersection	4	4
Total Volume Condition Met	Yes	Yes
Warrant Met for Approach	No	Yes
Warrant Met for Intersection	**Yes**	

Signal Warrants Report For Intersection 10: Andrew St/ Henshall St

Warrants Summary

Warrant	Name	Met?
#1	Eight Hour Vehicular Volume	Yes
#2	Four Hour Vehicular Volume	Yes
#3	Peak Hour	No

Intersection Warrants Parameters

Major Approaches	S, W
Minor Approaches	E
Speed > 40mph	Yes
Population < 10,000	No
Warrant Factor	56%

Warrant Analysis Traffic Volumes

Hour	Major Streets		Minor Streets
	S	W	E
1	448	423	135
2	435	410	131
3	426	402	128
4	399	376	120
5	354	334	107
6	349	330	105
7	345	326	104
8	314	296	95
9	309	292	93
10	305	288	92
11	264	250	80
12	246	233	74
13	242	228	73
14	179	169	54
15	179	169	54
16	125	118	38
17	72	68	22
18	72	68	22
19	40	38	12
20	22	21	7
21	13	13	4
22	4	4	1
23	4	4	1
24	4	4	1

Warrant Analysis by Hour

Hour	Major Streets		Minor Street		Warrant 1 Condition A				Warrant 1 Condition B				Warrant 2	Warrant 3
	Number	Volume	Number	Volume	100%	80%	70%	56%	100%	80%	70%	56%		Condition B
1	2	871	1	135	No	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes	No
2	2	845	1	131	No	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes	No
3	2	828	1	128	No	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes	No
4	2	775	1	120	No	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes	No
5	2	688	1	107	No	No	Yes	Yes	No	No	Yes	Yes	Yes	No
6	2	679	1	105	No	No	Yes	Yes	No	No	Yes	Yes	No	No
7	2	671	1	104	No	No	No	Yes	No	No	Yes	Yes	No	No
8	2	610	1	95	No	No	No	Yes	No	No	No	Yes	No	No
9	2	601	1	93	No	No	No	Yes	No	No	No	Yes	No	No
10	2	593	1	92	No	No	No	Yes	No	No	No	Yes	No	No
11	2	514	1	80	No	No	No	No	No	No	No	Yes	No	No
12	2	479	1	74	No	No	No	No	No	No	No	No	No	No
13	2	470	1	73	No	No	No	No	No	No	No	No	No	No
14	2	348	1	54	No	No	No	No	No	No	No	No	No	No
15	2	348	1	54	No	No	No	No	No	No	No	No	No	No
16	2	243	1	38	No	No	No	No	No	No	No	No	No	No
17	2	140	1	22	No	No	No	No	No	No	No	No	No	No
18	2	140	1	22	No	No	No	No	No	No	No	No	No	No
19	2	78	1	12	No	No	No	No	No	No	No	No	No	No
20	2	43	1	7	No	No	No	No	No	No	No	No	No	No
21	2	26	1	4	No	No	No	No	No	No	No	No	No	No
22	2	8	1	1	No	No	No	No	No	No	No	No	No	No
23	2	8	1	1	No	No	No	No	No	No	No	No	No	No
24	2	8	1	1	No	No	No	No	No	No	No	No	No	No
Hours Met					0	4	6	10	0	4	7	11	5	0

Warrant 3 Condition A

Orientation	E
Total Stopped Delay Per Vehicle on Minor Approach (s)	10,5
Number of Lanes on Minor Street Approach	1
VehicleHours of Stopped Delay on Minor Approach ([h]h:mm)	0:23
Delay Condition Met	No
Volume on Minor Street Approach During Same Hour	135
High Minor Volume Condition Met	Yes
Total Entering Volume on All Approaches During Same Hour	1006
Number of Approaches on Intersection	3
Total Volume Condition Met	Yes
Warrant Met for Approach	No
Warrant Met for Intersection	**No**

Signal Warrants Report For Intersection 12: Andrew St/ Paul Kruger St

Warrants Summary

Warrant	Name	Met?
#1	Eight Hour Vehicular Volume	Yes
#2	Four Hour Vehicular Volume	Yes
#3	Peak Hour	Yes

Intersection Warrants Parameters

Major Approaches	E, W
Minor Approaches	S
Speed > 40mph	Yes
Population < 10,000	No
Warrant Factor	70%

Warrant Analysis Traffic Volumes

Hour	Major Streets		Minor Streets
	E	W	S
1	919	1187	483
2	891	1151	469
3	873	1128	459
4	818	1056	430
5	726	938	382
6	717	926	377
7	708	914	372
8	643	831	338
9	634	819	333
10	625	807	328
11	542	700	285
12	505	653	266
13	496	641	261
14	368	475	193
15	368	475	193
16	257	332	135
17	147	190	77
18	147	190	77
19	83	107	43
20	46	59	24
21	28	36	14
22	9	12	5
23	9	12	5
24	9	12	5

Warrant Analysis by Hour

Hour	Major Streets		Minor Street		Warrant 1 Condition A				Warrant 1 Condition B				Warrant 2	Warrant 3
	Number	Volume	Number	Volume	100%	80%	70%	56%	100%	80%	70%	56%		Condition B
1	2	2106	2	483	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
2	2	2042	2	469	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
3	2	2001	2	459	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
4	2	1874	2	430	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
5	2	1664	2	382	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
6	2	1643	2	377	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
7	2	1622	2	372	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
8	2	1474	2	338	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
9	2	1453	2	333	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
10	2	1432	2	328	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
11	2	1242	2	285	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
12	2	1158	2	266	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
13	2	1137	2	261	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
14	2	843	2	193	No	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes	No
15	2	843	2	193	No	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes	No
16	2	589	2	135	No	No	No	Yes	No	No	No	Yes	No	No
17	2	337	2	77	No	No	No	No	No	No	No	No	No	No
18	2	337	2	77	No	No	No	No	No	No	No	No	No	No
19	2	190	2	43	No	No	No	No	No	No	No	No	No	No
20	2	105	2	24	No	No	No	No	No	No	No	No	No	No
21	2	64	2	14	No	No	No	No	No	No	No	No	No	No
22	2	21	2	5	No	No	No	No	No	No	No	No	No	No
23	2	21	2	5	No	No	No	No	No	No	No	No	No	No
24	2	21	2	5	No	No	No	No	No	No	No	No	No	No
Hours Met					13	15	15	16	13	15	15	16	15	13

Warrant 3 Condition A

Orientation	S
Total Stopped Delay Per Vehicle on Minor Approach (s)	54,5
Number of Lanes on Minor Street Approach	2
VehicleHours of Stopped Delay on Minor Approach ([h]h:mm)	7:19
Delay Condition Met	Yes
Volume on Minor Street Approach During Same Hour	483
High Minor Volume Condition Met	Yes
Total Entering Volume on All Approaches During Same Hour	2589
Number of Approaches on Intersection	3
Total Volume Condition Met	Yes
Warrant Met for Approach	Yes
Warrant Met for Intersection	**Yes**

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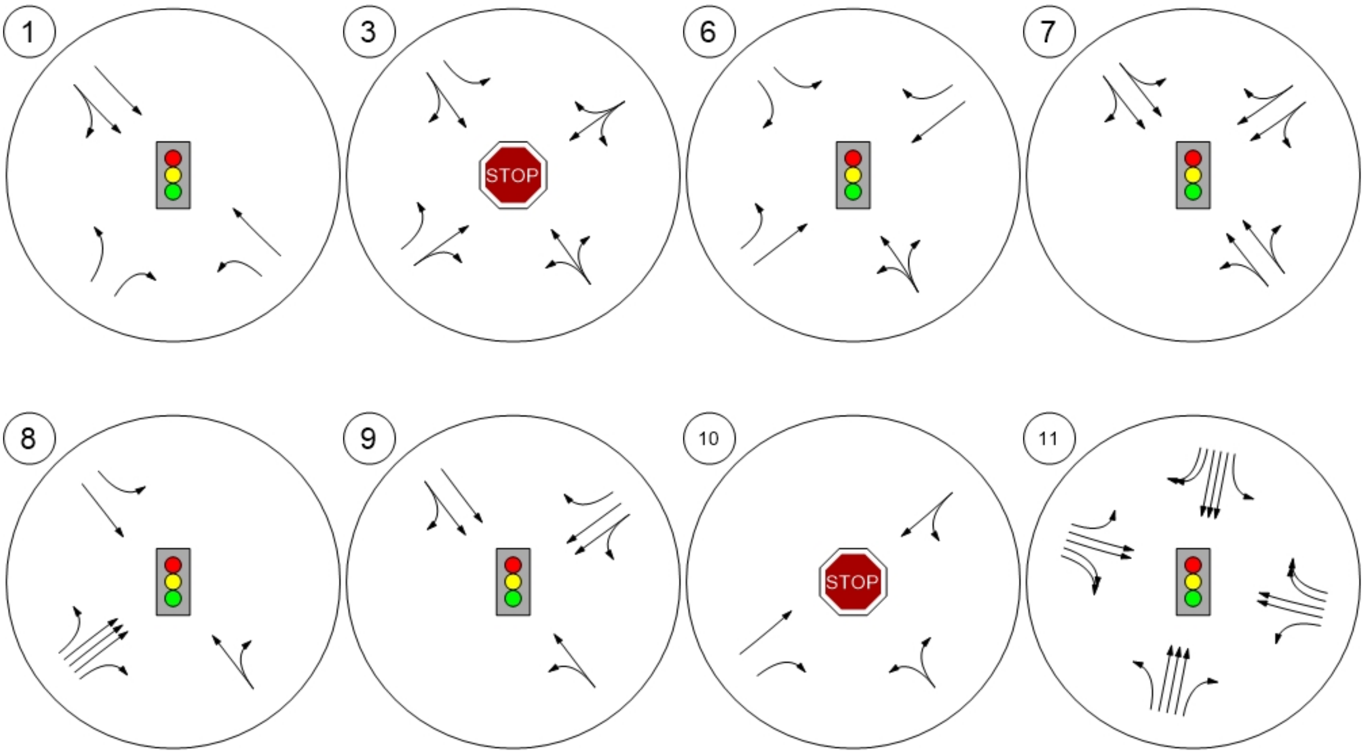
Study Intersections

Lane Configuration and Traffic Control



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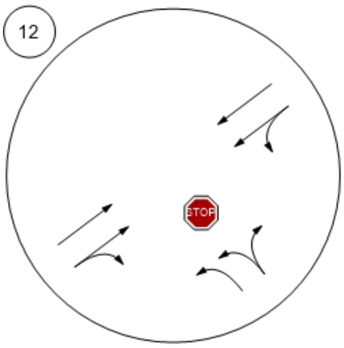
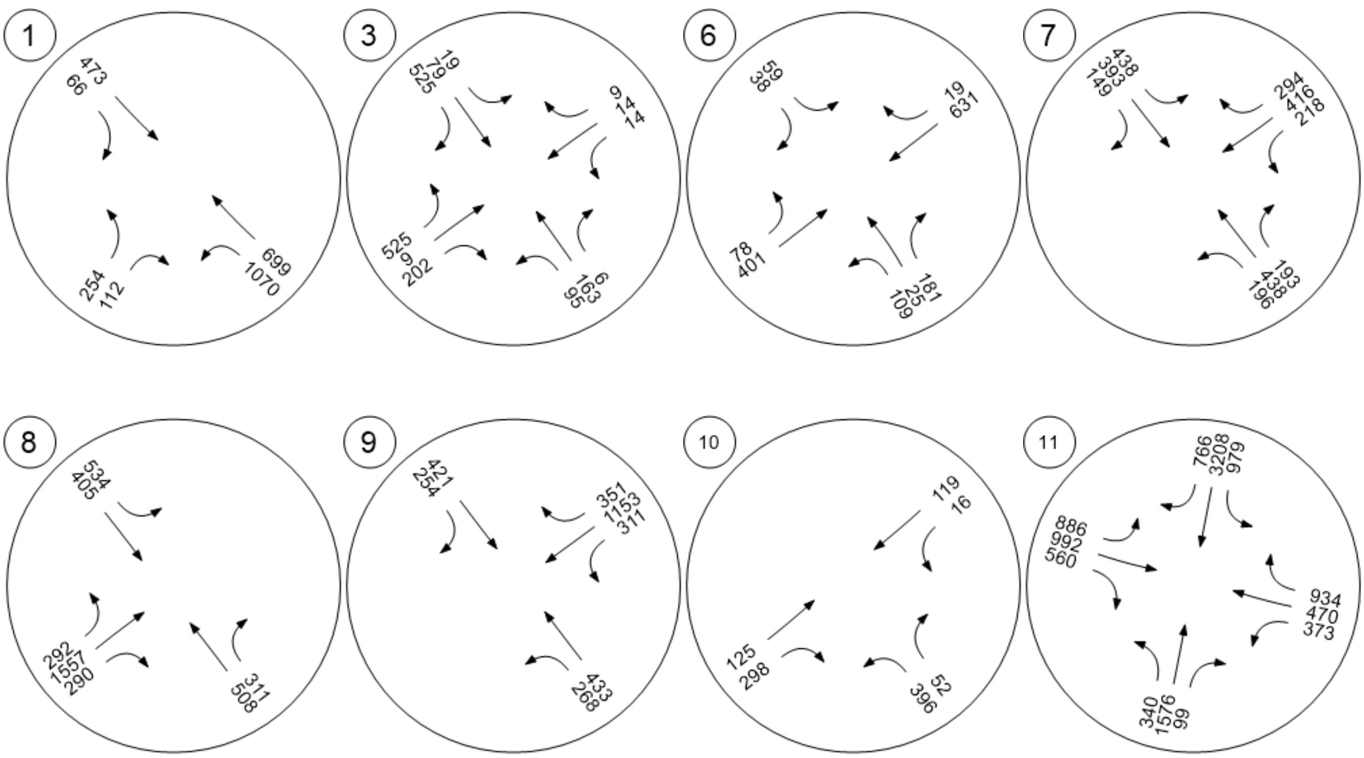
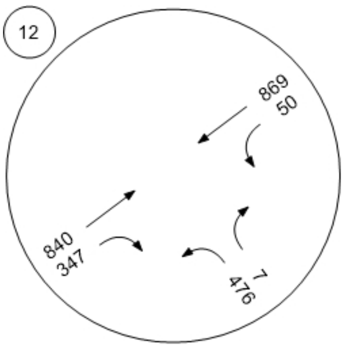
Lane Configuration and Traffic Control



Traffic Volume - Base Volume



Traffic Volume - Base Volume



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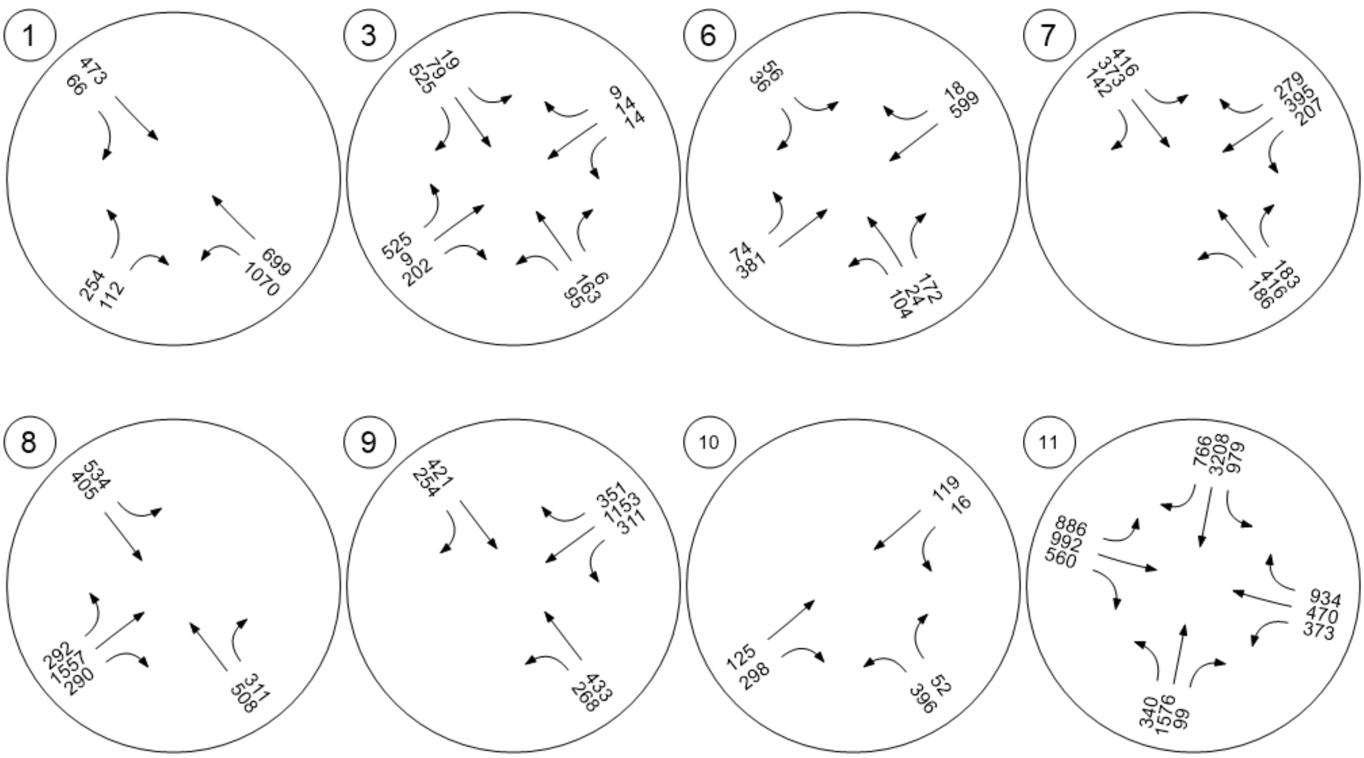
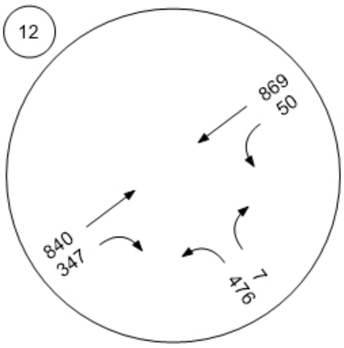
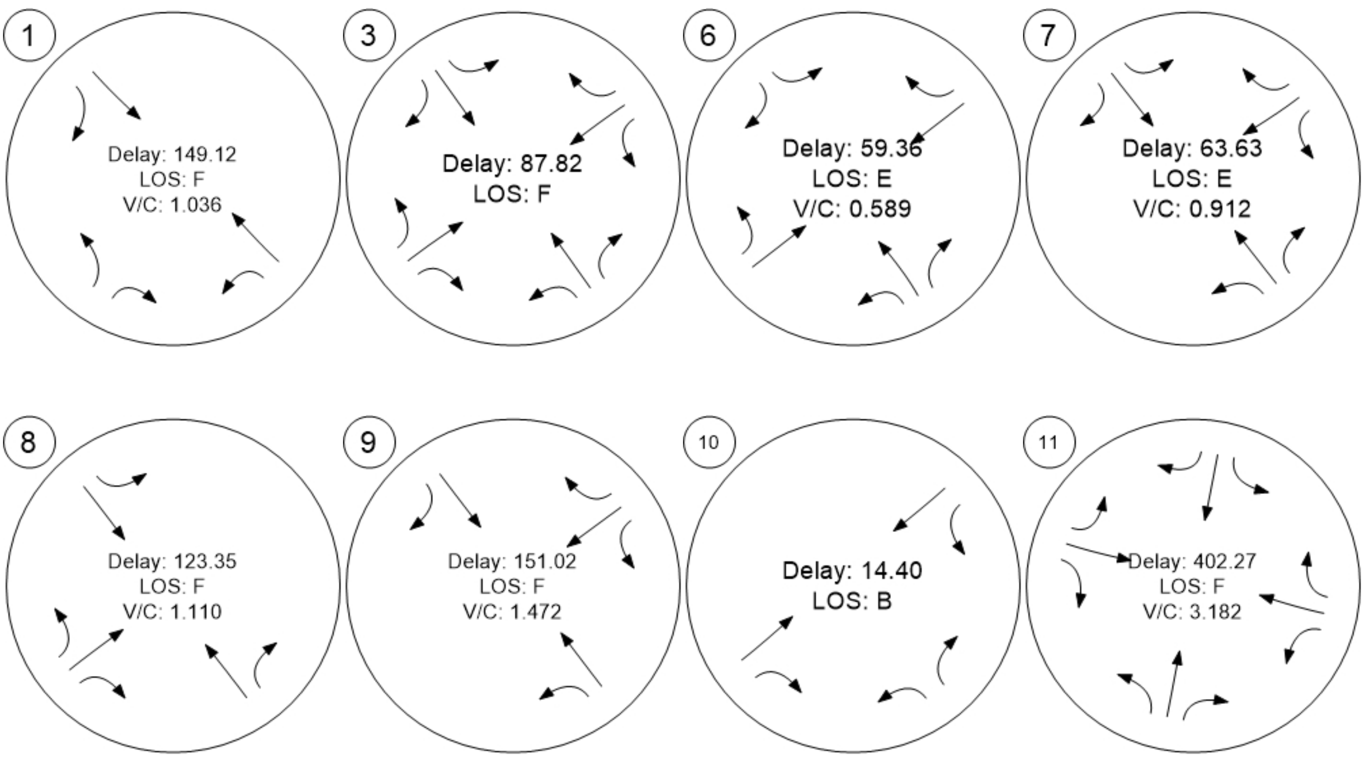
Traffic Volume - Future Total Volume



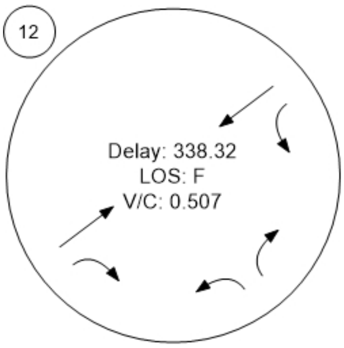
Traffic Volume - Future Total Volume



Traffic Conditions



Traffic Conditions



APPENDIX 6.4: PM Peak without Mini-bus Taxis

Vistro File: \...\Analysis of intersections in Mbombela.vistro
Report File: N:\...\4. 2021 PM Peak (without taxis).pdf

Scenario 4 2021 PM Peak (without taxis)
2021/11/02

Intersection Analysis Summary

ID	Intersection Name	Control Type	Method	Worst Mvmt	V/C	Delay (s/veh)	LOS
1	D2296/ Friedenheim Rd	Signalized	HCM 6th Edition	WB Left	0,944	104,8	F
3	Kragbron Rd/ Timerhout St	All-way stop	HCM 6th Edition	SB Right	1,139	54,9	F
6	Bester St/ Corrier St	Signalized	HCM 6th Edition	NB Right	0,504	44,1	D
7	Bester St/ Henshall St.	Signalized	HCM 6th Edition	NB Right	0,778	55,4	E
8	Samora Machel Dr/ Henshall St.	Signalized	HCM 6th Edition	EB Thru	1,087	99,2	F
9	Bell St./Henshall St.	Signalized	HCM 6th Edition	SB Right	0,958	61,1	E
10	Andrew St/ Henshall St	All-way stop	HCM 6th Edition	EB Right	0,511	12,2	B
11	Old Pretoria Rd/ Madiba Dr	Signalized	HCM 6th Edition	WB Right	3,047	364,9	F
12	Andrew St/ Paul Kruger St	Two-way stop	HCM 6th Edition	NB Right	0,300	182,2	F

V/C, Delay, LOS: For two-way stop, these values are taken from the movement with the worst (highest) delay value. For all other control types, they are taken for the whole intersection.

Intersection Level Of Service Report
Intersection 1: D2296/ Friedenheim Rd

Control Type:	Signalized	Delay (sec / veh):	104,8
Analysis Method:	HCM 6th Edition	Level Of Service:	F
Analysis Period:	15 minutes	Volume to Capacity (v/c):	0,944

Intersection Setup

Name	Friedenheim St		D2296		D2296	
Approach	Northbound		Southbound		Westbound	
Lane Configuration						
Turning Movement	Left	Right	Thru	Right	Left	Thru
Lane Width [m]	3,70	3,70	3,70	3,70	3,70	3,70
No. of Lanes in Entry Pocket	0	0	1	0	0	0
Entry Pocket Length [m]	30,48	30,48	60,00	30,48	30,48	30,48
No. of Lanes in Exit Pocket	0	0	0	0	0	0
Exit Pocket Length [m]	0,00	0,00	0,00	0,00	0,00	0,00
Speed [km/h]	48,28		60,00		60,00	
Grade [%]	0,00		0,00		0,00	
Curb Present	No		No		No	
Crosswalk	No		No		No	

Volumes

Name	Friedenheim St		D2296		D2296	
Base Volume Input [veh/h]	254	98	473	66	931	699
Base Volume Adjustment Factor	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000
Heavy Vehicles Percentage [%]	2,00	2,00	2,00	2,00	2,00	2,00
Growth Factor	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000
In-Process Volume [veh/h]	0	0	0	0	0	0
Site-Generated Trips [veh/h]	0	0	0	0	0	0
Diverted Trips [veh/h]	0	0	0	0	0	0
Pass-by Trips [veh/h]	0	0	0	0	0	0
Existing Site Adjustment Volume [veh/h]	0	0	0	0	0	0
Other Volume [veh/h]	0	0	0	0	0	0
Left-Turn on Red Volume [veh/h]	0	0	0	0	0	0
Total Hourly Volume [veh/h]	254	98	473	66	931	699
Peak Hour Factor	0,9500	0,9500	0,9500	0,9500	0,9500	0,9500
Other Adjustment Factor	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000
Total 15-Minute Volume [veh/h]	67	26	124	17	245	184
Total Analysis Volume [veh/h]	267	103	498	69	980	736
Presence of On-Street Parking	No	No	No	No	No	No
On-Street Parking Maneuver Rate [/h]	0	0	0	0	0	0
Local Bus Stopping Rate [/h]	0	0	0	0	0	0
v_do, Outbound Pedestrian Volume crossing	0		0		0	
v_di, Inbound Pedestrian Volume crossing m	0		0		0	
v_co, Outbound Pedestrian Volume crossing	0		0		0	
v_ci, Inbound Pedestrian Volume crossing mi	0		0		0	
v_ab, Corner Pedestrian Volume [ped/h]	0		0		0	
Bicycle Volume [bicycles/h]	0		0		0	

Intersection Settings

Located in CBD	No
Signal Coordination Group	-
Cycle Length [s]	180
Coordination Type	Time of Day Pattern Coordinated
Actuation Type	Fully actuated
Offset [s]	0,0
Offset Reference	Lead Green - Beginning of First Green
Permissive Mode	SingleBand
Lost time [s]	0,00

Phasing & Timing

Control Type	Permissive	Permissive	Permissive	Permissive	Permissive	Permissive
Signal Group	0	1	2	0	0	4
Auxiliary Signal Groups						
Lead / Lag	-	Lead	-	-	-	-
Minimum Green [s]	0	5	10	0	0	10
Maximum Green [s]	0	30	30	0	0	30
Amber [s]	0,0	3,0	3,0	0,0	0,0	3,0
All red [s]	0,0	1,0	1,0	0,0	0,0	1,0
Split [s]	0	29	32	0	0	119
Vehicle Extension [s]	0,0	3,0	3,0	0,0	0,0	3,0
Walk [s]	0	5	5	0	0	5
Pedestrian Clearance [s]	0	10	10	0	0	10
Delayed Vehicle Green [s]	0,0	0,0	0,0	0,0	0,0	0,0
Rest In Walk		No	No			No
I1, Start-Up Lost Time [s]	0,0	2,0	2,0	0,0	0,0	2,0
I2, Clearance Lost Time [s]	0,0	2,0	2,0	0,0	0,0	2,0
Minimum Recall		No	No			No
Maximum Recall		No	No			No
Pedestrian Recall		No	No			No
Detector Location [m]	0,0	0,0	0,0	0,0	0,0	0,0
Detector Length [m]	0,0	0,0	0,0	0,0	0,0	0,0
I, Upstream Filtering Factor	1,00	1,00	1,00	1,00	1,00	1,00

Exclusive Pedestrian Phase

Pedestrian Signal Group	0
Pedestrian Walk [s]	0
Pedestrian Clearance [s]	0

Lane Group Calculations

Lane Group	L	R	C	C	L	C
C, Cycle Length [s]	70	70	70	70	70	70
L, Total Lost Time per Cycle [s]	4,00	4,00	4,00	4,00	4,00	4,00
l1_p, Permitted Start-Up Lost Time [s]	0,00	0,00	0,00	0,00	0,00	0,00
l2, Clearance Lost Time [s]	2,00	2,00	2,00	2,00	2,00	2,00
g_i, Effective Green Time [s]	14	14	14	14	30	30
g / C, Green / Cycle	0,20	0,20	0,20	0,20	0,43	0,43
(v / s)_i Volume / Saturation Flow Rate	0,17	0,06	0,16	0,16	0,62	0,39
s, saturation flow rate [veh/h]	1589	1781	1702	1848	1589	1870
c, Capacity [veh/h]	323	362	339	369	678	798
d1, Uniform Delay [s]	26,82	23,68	26,82	26,83	20,17	19,07
k, delay calibration	0,11	0,11	0,11	0,11	0,50	0,39
I, Upstream Filtering Factor	1,00	1,00	1,00	1,00	1,00	1,00
d2, Incremental Delay [s]	5,34	0,43	4,37	4,08	208,75	14,88
d3, Initial Queue Delay [s]	0,00	0,00	0,00	0,00	0,00	0,00
Rp, platoon ratio	1,00	1,00	1,00	1,00	1,00	1,00
PF, progression factor	1,00	1,00	1,00	1,00	1,00	1,00

Lane Group Results

X, volume / capacity	0,83	0,28	0,80	0,80	1,45	0,92
d, Delay for Lane Group [s/veh]	32,16	24,11	31,19	30,91	228,92	33,96
Lane Group LOS	C	C	C	C	F	C
Critical Lane Group	Yes	No	No	Yes	Yes	No
50th-Percentile Queue Length [veh/ln]	4,54	1,43	4,42	4,78	48,72	12,95
50th-Percentile Queue Length [m/ln]	34,62	10,87	33,69	36,44	371,24	98,72
95th-Percentile Queue Length [veh/ln]	8,04	2,57	7,87	8,37	74,83	18,86
95th-Percentile Queue Length [m/ln]	61,25	19,57	59,97	63,77	570,19	143,69

Movement, Approach, & Intersection Results

d_M, Delay for Movement [s/veh]	32,16	24,11	31,06	30,91	228,92	33,96
Movement LOS	C	C	C	C	F	C
d_A, Approach Delay [s/veh]	29,92		31,04		145,30	
Approach LOS	C		C		F	
d_I, Intersection Delay [s/veh]	104,79					
Intersection LOS	F					
Intersection V/C	0,944					

Other Modes

g_Walk,mi, Effective Walk Time [s]	0,0	0,0	0,0
M_corner, Corner Circulation Area [m²/ped]	0,00	0,00	0,00
M_CW, Crosswalk Circulation Area [m²/ped]	0,00	0,00	0,00
d_p, Pedestrian Delay [s]	0,00	0,00	0,00
I_p,int, Pedestrian LOS Score for Intersection	0,000	0,000	0,000
Crosswalk LOS	F	F	F
s_b, Saturation Flow Rate of the bicycle lane	2000	2000	2000
c_b, Capacity of the bicycle lane [bicycles/h]	712	798	3276
d_b, Bicycle Delay [s]	14,56	12,69	14,28
I_b,int, Bicycle LOS Score for Intersection	1,560	2,027	4,391
Bicycle LOS	A	B	E

Sequence

Ring 1	1	2	-	4	-	-	-	-	-	-	-	-	-	-	-	-
Ring 2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Ring 3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Ring 4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Intersection Level Of Service Report
Intersection 3: Kragbron Rd/ Timerhout St

Control Type:	All-way stop	Delay (sec / veh):	54,9
Analysis Method:	HCM 6th Edition	Level Of Service:	F
Analysis Period:	15 minutes	Volume to Capacity (v/c):	1,139

Intersection Setup

Name	Kragbron Rd			Kragbron Rd			Bester Street			Timerhout St		
Approach	Northbound			Southbound			Eastbound			Westbound		
Lane Configuration												
Turning Movement	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right
Lane Width [m]	3,70	3,70	3,70	3,70	3,70	3,70	3,70	3,70	3,70	3,70	3,70	3,70
No. of Lanes in Entry Pocket	0	0	0	1	0	0	1	0	0	0	0	0
Entry Pocket Length [m]	30,48	30,48	30,48	110,00	30,48	30,48	60,00	30,48	30,48	30,48	30,48	30,48
No. of Lanes in Exit Pocket	0	0	0	0	0	0	0	0	0	0	0	0
Exit Pocket Length [m]	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
Speed [km/h]	60,00			48,28			60,00			60,00		
Grade [%]	0,00			0,00			0,00			0,00		
Crosswalk	No			No			No			No		

Volumes

Name	Kragbron Rd			Kragbron Rd			Bester Street			Timerhout St		
Base Volume Input [veh/h]	95	163	6	19	79	457	457	9	202	14	14	9
Base Volume Adjustment Factor	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000
Heavy Vehicles Percentage [%]	2,00	2,00	2,00	2,00	2,00	2,00	2,00	2,00	2,00	2,00	2,00	2,00
Growth Factor	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000
In-Process Volume [veh/h]	0	0	0	0	0	0	0	0	0	0	0	0
Site-Generated Trips [veh/h]	0	0	0	0	0	0	0	0	0	0	0	0
Diverted Trips [veh/h]	0	0	0	0	0	0	0	0	0	0	0	0
Pass-by Trips [veh/h]	0	0	0	0	0	0	0	0	0	0	0	0
Existing Site Adjustment Volume [veh/h]	0	0	0	0	0	0	0	0	0	0	0	0
Other Volume [veh/h]	0	0	0	0	0	0	0	0	0	0	0	0
Total Hourly Volume [veh/h]	95	163	6	19	79	457	457	9	202	14	14	9
Peak Hour Factor	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000
Other Adjustment Factor	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000
Total 15-Minute Volume [veh/h]	24	41	2	5	20	114	114	2	51	4	4	2
Total Analysis Volume [veh/h]	95	163	6	19	79	457	457	9	202	14	14	9
Pedestrian Volume [ped/h]	0			0			0			0		

Intersection Settings

Lanes

Capacity per Entry Lane [veh/h]	488	554	536	555	470	422
Degree of Utilization, x	0,54	0,03	1,14	0,82	0,45	0,09

Movement, Approach, & Intersection Results

95th-Percentile Queue Length [veh]	3,17	0,11	18,83	8,34	2,28	0,29
95th-Percentile Queue Length [m]	24,13	0,81	143,51	63,57	17,40	2,18
Approach Delay [s/veh]	18,68	108,01		27,53		12,35
Approach LOS	C	F		D		B
Intersection Delay [s/veh]	54,94					
Intersection LOS	F					

Intersection Level Of Service Report
Intersection 6: Bester St/ Corrier St

Control Type:	Signalized	Delay (sec / veh):	44,1
Analysis Method:	HCM 6th Edition	Level Of Service:	D
Analysis Period:	15 minutes	Volume to Capacity (v/c):	0,504

Intersection Setup

Name	Currier St.			Currier St.			Bester St.			Bester Street		
Approach	Northbound			Southbound			Eastbound			Westbound		
Lane Configuration												
Turning Movement	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right
Lane Width [m]	3,70	3,70	3,70	3,70	3,70	3,70	3,70	3,70	3,66	3,66	3,70	3,70
No. of Lanes in Entry Pocket	0	0	0	0	0	1	0	0	0	0	0	1
Entry Pocket Length [m]	30,48	30,48	30,48	30,48	30,48	10,00	30,48	30,48	30,48	30,48	30,48	60,00
No. of Lanes in Exit Pocket	0	0	0	0	0	0	0	0	0	0	0	0
Exit Pocket Length [m]	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
Speed [km/h]	60,00			60,00			60,00			60,00		
Grade [%]	0,00			0,00			0,00			0,00		
Curb Present	No			No			No			No		
Crosswalk	Yes			Yes			Yes			Yes		

Volumes

Name	Currier St.			Currier St.			Bester St.			Bester Street		
Base Volume Input [veh/h]	109	25	181	0	0	0	78	401	0	0	549	19
Base Volume Adjustment Factor	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000
Heavy Vehicles Percentage [%]	2,00	2,00	2,00	2,00	2,00	2,00	2,00	2,00	2,00	2,00	2,00	2,00
Growth Factor	0,9500	0,9500	0,9500	0,9500	1,0000	0,9500	0,9500	0,9500	1,0000	1,0000	0,9500	0,9500
In-Process Volume [veh/h]	0	0	0	0	0	0	0	0	0	0	0	0
Site-Generated Trips [veh/h]	0	0	0	0	0	0	0	0	0	0	0	0
Diverted Trips [veh/h]	0	0	0	0	0	0	0	0	0	0	0	0
Pass-by Trips [veh/h]	0	0	0	0	0	0	0	0	0	0	0	0
Existing Site Adjustment Volume [veh/h]	0	0	0	0	0	0	0	0	0	0	0	0
Other Volume [veh/h]	0	0	0	0	0	0	0	0	0	0	0	0
Left-Turn on Red Volume [veh/h]	0	0	0	0	0	0	0	0	0	0	0	0
Total Hourly Volume [veh/h]	104	24	172	0	0	0	74	381	0	0	522	18
Peak Hour Factor	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000
Other Adjustment Factor	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000
Total 15-Minute Volume [veh/h]	26	6	43	0	0	0	19	95	0	0	131	5
Total Analysis Volume [veh/h]	104	24	172	0	0	0	74	381	0	0	522	18
Presence of On-Street Parking	No		No	No		No	No		No	No		No
On-Street Parking Maneuver Rate [/h]	0	0	0	0	0	0	0	0	0	0	0	0
Local Bus Stopping Rate [/h]	0	0	0	0	0	0	0	0	0	0	0	0
v_do, Outbound Pedestrian Volume crossing	0			0			0			0		
v_di, Inbound Pedestrian Volume crossing m	0			0			0			0		
v_co, Outbound Pedestrian Volume crossing	0			0			0			0		
v_ci, Inbound Pedestrian Volume crossing mi	0			0			0			0		
v_ab, Corner Pedestrian Volume [ped/h]	0			0			0			0		
Bicycle Volume [bicycles/h]	0			0			0			0		

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Version 2021 (SP 0-6)

Intersection Settings

Located in CBD	Yes
Signal Coordination Group	-
Cycle Length [s]	240
Coordination Type	Time of Day Pattern Coordinated
Actuation Type	Fixed time
Offset [s]	0,0
Offset Reference	Lead Green - Beginning of First Green
Permissive Mode	SingleBand
Lost time [s]	0,00

Phasing & Timing

Control Type	Permiss	Permiss	Permiss	Permiss	Permiss	Permiss	Permiss	Permiss	Permiss	Permiss	Permiss	Permiss
Signal Group	0	6	0	0	0	5	0	8	0	0	4	0
Auxiliary Signal Groups												
Lead / Lag	-	-	-	-	-	Lead	-	-	-	-	-	-
Minimum Green [s]	0	10	0	0	0	5	0	10	0	0	10	0
Maximum Green [s]	0	30	0	0	0	30	0	30	0	0	30	0
Amber [s]	0,0	3,0	0,0	0,0	0,0	3,0	0,0	3,0	0,0	0,0	3,0	0,0
All red [s]	0,0	1,0	0,0	0,0	0,0	1,0	0,0	1,0	0,0	0,0	1,0	0,0
Split [s]	0	85	0	0	0	21	0	134	0	0	134	0
Vehicle Extension [s]	0,0	3,0	0,0	0,0	0,0	3,0	0,0	3,0	0,0	0,0	3,0	0,0
Walk [s]	0	5	0	0	0	5	0	5	0	0	5	0
Pedestrian Clearance [s]	0	12	0	0	0	12	0	12	0	0	6	0
Delayed Vehicle Green [s]	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Rest In Walk		No				No		No			No	
I1, Start-Up Lost Time [s]	0,0	2,0	0,0	0,0	0,0	2,0	0,0	2,0	0,0	0,0	2,0	0,0
I2, Clearance Lost Time [s]	0,0	2,0	0,0	0,0	0,0	2,0	0,0	2,0	0,0	0,0	2,0	0,0
Minimum Recall		No				No		No			No	
Maximum Recall		No				No		No			No	
Pedestrian Recall		No				No		No			No	
Detector Location [m]	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Detector Length [m]	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
I, Upstream Filtering Factor	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00

Exclusive Pedestrian Phase

Pedestrian Signal Group	0
Pedestrian Walk [s]	0
Pedestrian Clearance [s]	0

Lane Group Calculations

Lane Group	C	L	R	L	C	C	R
C, Cycle Length [s]	240	240	240	240	240	240	240
L, Total Lost Time per Cycle [s]	4,00	4,00	4,00	4,00	4,00	4,00	4,00
l1_p, Permitted Start-Up Lost Time [s]	0,00	0,00	0,00	0,00	0,00	0,00	2,00
l2, Clearance Lost Time [s]	2,00	2,00	2,00	2,00	2,00	2,00	2,00
g_i, Effective Green Time [s]	81	17	17	130	130	130	130
g / C, Green / Cycle	0,34	0,07	0,07	0,54	0,54	0,54	0,54
(v / s)_i Volume / Saturation Flow Rate	0,19	0,00	0,00	0,05	0,23	0,31	0,02
s, saturation flow rate [veh/h]	1544	1431	1603	1431	1683	1683	902
c, Capacity [veh/h]	521	101	114	775	912	912	390
d1, Uniform Delay [s]	65,37	0,00	0,00	26,58	32,59	36,54	44,20
k, delay calibration	0,50	0,50	0,50	0,50	0,50	0,50	0,50
I, Upstream Filtering Factor	1,00	1,00	1,00	1,00	1,00	1,00	1,00
d2, Incremental Delay [s]	4,57	0,00	0,00	0,25	1,41	2,61	0,22
d3, Initial Queue Delay [s]	0,00	0,00	0,00	0,00	0,00	0,00	0,00
Rp, platoon ratio	1,00	1,00	1,00	1,00	1,00	1,00	1,00
PF, progression factor	1,00	1,00	1,00	1,00	1,00	1,00	1,00

Lane Group Results

X, volume / capacity	0,58	0,00	0,00	0,10	0,42	0,57	0,05
d, Delay for Lane Group [s/veh]	69,94	0,00	0,00	26,83	34,00	39,15	44,42
Lane Group LOS	E	A	A	C	C	D	D
Critical Lane Group	Yes	No	No	No	No	Yes	No
50th-Percentile Queue Length [veh/ln]	15,91	0,00	0,00	2,19	13,82	21,35	0,70
50th-Percentile Queue Length [m/ln]	121,24	0,00	0,00	16,66	105,33	162,69	5,34
95th-Percentile Queue Length [veh/ln]	22,45	0,00	0,00	3,94	19,92	28,93	1,26
95th-Percentile Queue Length [m/ln]	171,08	0,00	0,00	29,99	151,79	220,43	9,61

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Movement, Approach, & Intersection Results

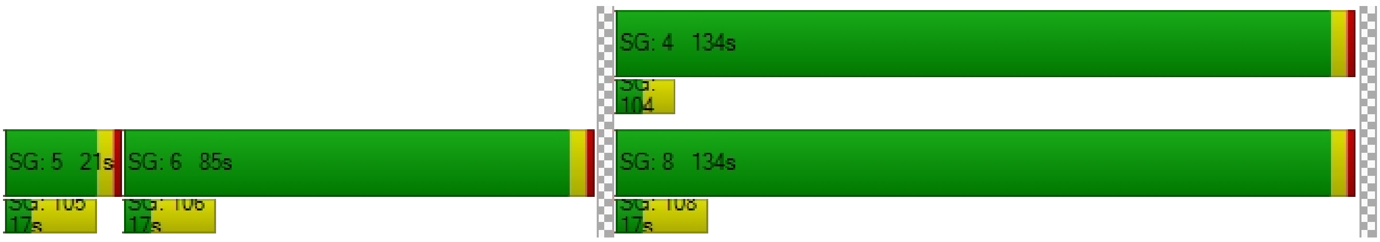
d_M, Delay for Movement [s/veh]	69,94	69,94	69,94	0,00	0,00	0,00	26,83	34,00	0,00	0,00	39,15	44,42
Movement LOS	E	E	E	A		A	C	C			D	D
d_A, Approach Delay [s/veh]	69,94			0,00			32,83			39,33		
Approach LOS	E			A			C			D		
d_I, Intersection Delay [s/veh]	44,14											
Intersection LOS	D											
Intersection V/C	0,504											

Other Modes

g_Walk,mi, Effective Walk Time [s]	9,0	9,0	9,0	9,0
M_corner, Corner Circulation Area [m²/ped]	0,00	0,00	0,00	0,00
M_CW, Crosswalk Circulation Area [m²/ped]	0,00	0,00	0,00	0,00
d_p, Pedestrian Delay [s]	111,17	111,17	111,17	111,17
I_p,int, Pedestrian LOS Score for Intersection	2,054	2,259	2,704	2,697
Crosswalk LOS	B	B	B	B
s_b, Saturation Flow Rate of the bicycle lane	2000	2000	2000	2000
c_b, Capacity of the bicycle lane [bicycles/h]	675	142	1083	1083
d_b, Bicycle Delay [s]	52,67	103,60	25,21	25,21
I_b,int, Bicycle LOS Score for Intersection	2,055	1,670	2,310	2,451
Bicycle LOS	B	A	B	B

Sequence

Ring 1	-	-	-	4	-	-	-	-	-	-	-	-	-	-	-	-
Ring 2	5	6	-	8	-	-	-	-	-	-	-	-	-	-	-	-
Ring 3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Ring 4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-



Intersection Level Of Service Report
Intersection 7: Bester St/ Henshall St.

Control Type:	Signalized	Delay (sec / veh):	55,4
Analysis Method:	HCM 6th Edition	Level Of Service:	E
Analysis Period:	15 minutes	Volume to Capacity (v/c):	0,778

Intersection Setup

Name	Henshall St.			Henshall St.			Bester St.			Bester St.		
Approach	Northbound			Southbound			Eastbound			Westbound		
Lane Configuration												
Turning Movement	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right
Lane Width [m]	3,70	3,70	3,70	3,70	3,70	3,70	3,66	3,66	3,66	3,70	3,70	3,70
No. of Lanes in Entry Pocket	0	0	0	0	0	0	0	0	0	0	0	0
Entry Pocket Length [m]	30,48	30,48	30,48	30,48	30,48	30,48	30,48	30,48	30,48	30,48	30,48	30,48
No. of Lanes in Exit Pocket	0	0	0	1	0	0	0	0	0	0	0	0
Exit Pocket Length [m]	0,00	0,00	0,00	15,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
Speed [km/h]	60,00			60,00			48,28			60,00		
Grade [%]	0,00			0,00			0,00			0,00		
Curb Present	No			No						No		
Crosswalk	Yes			Yes			Yes			Yes		

Volumes

Name	Henshall St.			Henshall St.			Bester St.			Bester St.		
Base Volume Input [veh/h]	170	438	193	381	342	149	0	0	0	189	362	294
Base Volume Adjustment Factor	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000
Heavy Vehicles Percentage [%]	2,00	2,00	2,00	2,00	2,00	2,00	2,00	2,00	2,00	2,00	2,00	2,00
Growth Factor	0,9500	0,9500	0,9500	0,9500	0,9500	0,9500	1,0000	1,0000	1,0000	0,9500	0,9500	0,9500
In-Process Volume [veh/h]	0	0	0	0	0	0	0	0	0	0	0	0
Site-Generated Trips [veh/h]	0	0	0	0	0	0	0	0	0	0	0	0
Diverted Trips [veh/h]	0	0	0	0	0	0	0	0	0	0	0	0
Pass-by Trips [veh/h]	0	0	0	0	0	0	0	0	0	0	0	0
Existing Site Adjustment Volume [veh/h]	0	0	0	0	0	0	0	0	0	0	0	0
Other Volume [veh/h]	0	0	0	0	0	0	0	0	0	0	0	0
Left-Turn on Red Volume [veh/h]	0	0	0	0	0	0	0	0	0	0	0	0
Total Hourly Volume [veh/h]	162	416	183	362	325	142	0	0	0	180	344	279
Peak Hour Factor	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000
Other Adjustment Factor	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000
Total 15-Minute Volume [veh/h]	41	104	46	91	81	36	0	0	0	45	86	70
Total Analysis Volume [veh/h]	162	416	183	362	325	142	0	0	0	180	344	279
Presence of On-Street Parking	No		No	No		No				No		No
On-Street Parking Maneuver Rate [/h]	0	0	0	0	0	0	0	0	0	0	0	0
Local Bus Stopping Rate [/h]	0	0	0	0	0	0	0	0	0	0	0	0
v_do, Outbound Pedestrian Volume crossing	0			0			0			0		
v_di, Inbound Pedestrian Volume crossing m	0			0			0			0		
v_co, Outbound Pedestrian Volume crossing	0			0			0			0		
v_ci, Inbound Pedestrian Volume crossing mi	0			0			0			0		
v_ab, Corner Pedestrian Volume [ped/h]	0			0			0			0		
Bicycle Volume [bicycles/h]	0			0			0			0		

Intersection Settings

Located in CBD	Yes
Signal Coordination Group	-
Cycle Length [s]	230
Coordination Type	Time of Day Pattern Coordinated
Actuation Type	Fixed time
Offset [s]	0,0
Offset Reference	Lead Green - Beginning of First Green
Permissive Mode	SingleBand
Lost time [s]	0,00

Phasing & Timing

Control Type	Permiss	Permiss	Permiss	Permiss	Permiss	Permiss	Permiss	Permiss	Permiss	Permiss	Permiss	Permiss
Signal Group	0	8	0	0	4	0	0	0	0	0	6	0
Auxiliary Signal Groups												
Lead / Lag	-	-	-	-	-	-	-	-	-	-	-	-
Minimum Green [s]	0	10	0	0	10	0	0	0	0	0	10	0
Maximum Green [s]	0	30	0	0	30	0	0	0	0	0	30	0
Amber [s]	0,0	3,0	0,0	0,0	3,0	0,0	0,0	0,0	0,0	0,0	3,0	0,0
All red [s]	0,0	1,0	0,0	0,0	1,0	0,0	0,0	0,0	0,0	0,0	1,0	0,0
Split [s]	0	144	0	0	144	0	0	0	0	0	86	0
Vehicle Extension [s]	0,0	3,0	0,0	0,0	3,0	0,0	0,0	0,0	0,0	0,0	3,0	0,0
Walk [s]	0	5	0	0	5	0	0	0	0	0	5	0
Pedestrian Clearance [s]	0	6	0	0	9	0	0	0	0	0	12	0
Delayed Vehicle Green [s]	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Rest In Walk		No			No						No	
I1, Start-Up Lost Time [s]	0,0	2,0	0,0	0,0	2,0	0,0	0,0	0,0	0,0	0,0	2,0	0,0
I2, Clearance Lost Time [s]	0,0	2,0	0,0	0,0	2,0	0,0	0,0	0,0	0,0	0,0	2,0	0,0
Minimum Recall		No			No						No	
Maximum Recall		No			No						No	
Pedestrian Recall		No			No						No	
Detector Location [m]	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Detector Length [m]	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
I, Upstream Filtering Factor	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00

Exclusive Pedestrian Phase

Pedestrian Signal Group	0
Pedestrian Walk [s]	0
Pedestrian Clearance [s]	0

Lane Group Calculations

Lane Group	C	C	C	C		C	C
C, Cycle Length [s]	230	230	230	230		230	230
L, Total Lost Time per Cycle [s]	4,00	4,00	4,00	4,00		4,00	4,00
l1_p, Permitted Start-Up Lost Time [s]	0,00	2,00	0,00	2,00		0,00	0,00
l2, Clearance Lost Time [s]	2,00	2,00	2,00	2,00		2,00	2,00
g_i, Effective Green Time [s]	140	140	140	140		82	82
g / C, Green / Cycle	0,61	0,61	0,61	0,61		0,36	0,36
(v / s)_i Volume / Saturation Flow Rate	0,40	0,51	0,42	0,44		0,26	0,26
s, saturation flow rate [veh/h]	1459	356	1379	579		1411	1630
c, Capacity [veh/h]	888	248	839	377		503	581
d1, Uniform Delay [s]	29,16	72,97	30,25	61,56		64,72	64,68
k, delay calibration	0,50	0,50	0,50	0,50		0,50	0,50
I, Upstream Filtering Factor	1,00	1,00	1,00	1,00		1,00	1,00
d2, Incremental Delay [s]	3,69	17,72	4,55	9,18		9,47	8,24
d3, Initial Queue Delay [s]	0,00	0,00	0,00	0,00		0,00	0,00
Rp, platoon ratio	1,00	1,00	1,00	1,00		1,00	1,00
PF, progression factor	1,00	1,00	1,00	1,00		1,00	1,00

Lane Group Results

X, volume / capacity	0,65	0,74	0,69	0,67		0,74	0,74
d, Delay for Lane Group [s/veh]	32,85	90,70	34,80	70,74		74,19	72,92
Lane Group LOS	C	F	C	E		E	E
Critical Lane Group	No	Yes	No	No		Yes	No
50th-Percentile Queue Length [veh/ln]	21,76	11,31	22,62	13,85		20,53	23,47
50th-Percentile Queue Length [m/ln]	165,81	86,20	172,40	105,57		156,44	178,85
95th-Percentile Queue Length [veh/ln]	29,41	16,83	30,42	19,96		27,96	31,42
95th-Percentile Queue Length [m/ln]	224,11	128,23	231,84	152,08		213,07	239,39

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Movement, Approach, & Intersection Results

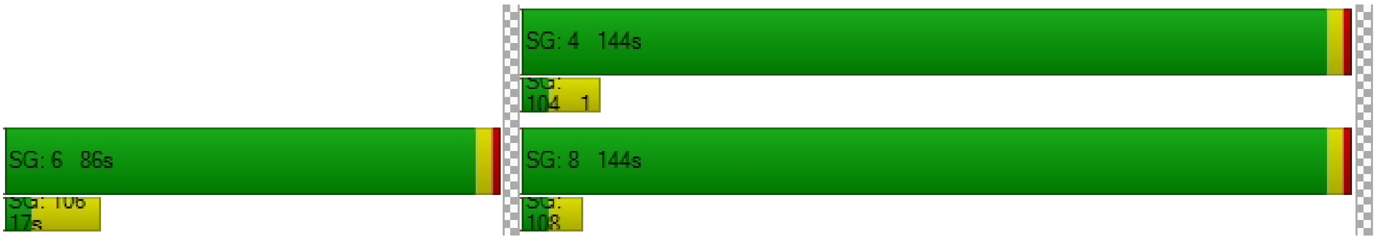
d_M, Delay for Movement [s/veh]	32,85	32,85	90,70	34,80	47,06	70,74	0,00	0,00	0,00	74,19	73,63	72,92
Movement LOS	C	C	F	C	D	E				E	E	E
d_A, Approach Delay [s/veh]	46,76			45,76			0,00			73,51		
Approach LOS	D			D			A			E		
d_I, Intersection Delay [s/veh]	55,39											
Intersection LOS	E											
Intersection V/C	0,778											

Other Modes

g_Walk,mi, Effective Walk Time [s]	9,0	9,0	9,0	9,0
M_corner, Corner Circulation Area [m²/ped]	0,00	0,00	0,00	0,00
M_CW, Crosswalk Circulation Area [m²/ped]	0,00	0,00	0,00	0,00
d_p, Pedestrian Delay [s]	106,18	106,18	106,18	106,18
I_p,int, Pedestrian LOS Score for Intersection	2,793	2,918	2,470	3,093
Crosswalk LOS	C	C	B	C
s_b, Saturation Flow Rate of the bicycle lane	2000	2000	2000	2000
c_b, Capacity of the bicycle lane [bicycles/h]	1217	1217	0	713
d_b, Bicycle Delay [s]	17,61	17,61	115,00	47,62
I_b,int, Bicycle LOS Score for Intersection	2,187	2,244	4,132	2,222
Bicycle LOS	B	B	D	B

Sequence

Ring 1	-	-	-	4	-	-	-	-	-	-	-	-	-	-	-	-
Ring 2	-	6	-	8	-	-	-	-	-	-	-	-	-	-	-	-
Ring 3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Ring 4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-



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Intersection Level Of Service Report

Intersection 8: Samora Machel Dr/ Henshall St.

Control Type:	Signalized	Delay (sec / veh):	99,2
Analysis Method:	HCM 6th Edition	Level Of Service:	F
Analysis Period:	15 minutes	Volume to Capacity (v/c):	1,087

Intersection Setup

Name	Henshall St.			Henshall St.			Samora Machel Dr.			Samora Machel Dr.		
Approach	Northbound			Southbound			Eastbound			Westbound		
Lane Configuration												
Turning Movement	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right
Lane Width [m]	3,66	3,70	3,70	3,70	3,70	3,66	3,70	3,70	3,70	3,66	3,66	3,66
No. of Lanes in Entry Pocket	0	0	0	0	0	0	1	0	1	0	0	0
Entry Pocket Length [m]	30,48	30,48	30,48	30,48	30,48	30,48	100,00	30,48	100,00	30,48	30,48	30,48
No. of Lanes in Exit Pocket	0	0	0	0	0	0	0	0	0	0	0	0
Exit Pocket Length [m]	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
Speed [km/h]	48,28			60,00			60,00			48,28		
Grade [%]	0,00			0,00			0,00			0,00		
Curb Present	No			No			No					
Crosswalk	Yes			Yes			Yes			Yes		

Volumes

Name	Henshall St.			Henshall St.			Samora Machel Dr.			Samora Machel Dr.		
Base Volume Input [veh/h]	0	442	311	465	405	0	292	1557	290	0	0	0
Base Volume Adjustment Factor	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000
Heavy Vehicles Percentage [%]	2,00	2,00	2,00	2,00	2,00	2,00	2,00	2,00	2,00	2,00	2,00	2,00
Growth Factor	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000
In-Process Volume [veh/h]	0	0	0	0	0	0	0	0	0	0	0	0
Site-Generated Trips [veh/h]	0	0	0	0	0	0	0	0	0	0	0	0
Diverted Trips [veh/h]	0	0	0	0	0	0	0	0	0	0	0	0
Pass-by Trips [veh/h]	0	0	0	0	0	0	0	0	0	0	0	0
Existing Site Adjustment Volume [veh/h]	0	0	0	0	0	0	0	0	0	0	0	0
Other Volume [veh/h]	0	0	0	0	0	0	0	0	0	0	0	0
Left-Turn on Red Volume [veh/h]	0	0	0	0	0	0	0	0	0	0	0	0
Total Hourly Volume [veh/h]	0	442	311	465	405	0	292	1557	290	0	0	0
Peak Hour Factor	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000
Other Adjustment Factor	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000
Total 15-Minute Volume [veh/h]	0	111	78	116	101	0	73	389	73	0	0	0
Total Analysis Volume [veh/h]	0	442	311	465	405	0	292	1557	290	0	0	0
Presence of On-Street Parking	No		No	No		No	No		No			
On-Street Parking Maneuver Rate [/h]	0	0	0	0	0	0	0	0	0	0	0	0
Local Bus Stopping Rate [/h]	0	0	0	0	0	0	0	0	0	0	0	0
v_do, Outbound Pedestrian Volume crossing		0			0			0			0	
v_di, Inbound Pedestrian Volume crossing m		0			0			0			0	
v_co, Outbound Pedestrian Volume crossing		0			0			0			0	
v_ci, Inbound Pedestrian Volume crossing mi		0			0			0			0	
v_ab, Corner Pedestrian Volume [ped/h]		0			0			0			0	
Bicycle Volume [bicycles/h]		0			0			0			0	

Intersection Settings

Located in CBD	Yes
Signal Coordination Group	-
Cycle Length [s]	240
Coordination Type	Time of Day Pattern Coordinated
Actuation Type	Fixed time
Offset [s]	0,0
Offset Reference	Lead Green - Beginning of First Green
Permissive Mode	SingleBand
Lost time [s]	0,00

Phasing & Timing

Control Type	Permiss	Permiss	Permiss	Permiss	Permiss	Permiss	Permiss	Permiss	Permiss	Permiss	Permiss	Permiss
Signal Group	0	6	0	0	2	0	0	8	0	0	0	0
Auxiliary Signal Groups												
Lead / Lag	-	-	-	-	-	-	-	-	-	-	-	-
Minimum Green [s]	0	10	0	0	10	0	0	10	0	0	0	0
Maximum Green [s]	0	30	0	0	30	0	0	30	0	0	0	0
Amber [s]	0,0	3,0	0,0	0,0	3,0	0,0	0,0	3,0	0,0	0,0	0,0	0,0
All red [s]	0,0	1,0	0,0	0,0	1,0	0,0	0,0	1,0	0,0	0,0	0,0	0,0
Split [s]	0	162	0	0	162	0	0	78	0	0	0	0
Vehicle Extension [s]	0,0	3,0	0,0	0,0	3,0	0,0	0,0	3,0	0,0	0,0	0,0	0,0
Walk [s]	0	5	0	0	5	0	0	5	0	0	0	0
Pedestrian Clearance [s]	0	22	0	0	12	0	0	12	0	0	0	0
Delayed Vehicle Green [s]	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Rest In Walk		No			No			No				
I1, Start-Up Lost Time [s]	0,0	2,0	0,0	0,0	2,0	0,0	0,0	2,0	0,0	0,0	0,0	0,0
I2, Clearance Lost Time [s]	0,0	2,0	0,0	0,0	2,0	0,0	0,0	2,0	0,0	0,0	0,0	0,0
Minimum Recall		No			No			No				
Maximum Recall		No			No			No				
Pedestrian Recall		No			No			No				
Detector Location [m]	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Detector Length [m]	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
I, Upstream Filtering Factor	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00

Exclusive Pedestrian Phase

Pedestrian Signal Group	0
Pedestrian Walk [s]	0
Pedestrian Clearance [s]	0

Lane Group Calculations

Lane Group	C	L	C	L	C	R	
C, Cycle Length [s]	240	240	240	240	240	240	
L, Total Lost Time per Cycle [s]	4,00	4,00	4,00	4,00	4,00	4,00	
l1_p, Permitted Start-Up Lost Time [s]	2,00	0,00	0,00	0,00	0,00	0,00	
l2, Clearance Lost Time [s]	2,00	2,00	2,00	2,00	2,00	2,00	
g_i, Effective Green Time [s]	158	158	158	74	74	74	
g / C, Green / Cycle	0,66	0,66	0,66	0,31	0,31	0,31	
(v / s)_i Volume / Saturation Flow Rate	0,75	0,33	0,24	0,20	0,34	0,18	
s, saturation flow rate [veh/h]	1007	1431	1683	1431	4584	1603	
c, Capacity [veh/h]	684	942	1108	441	1414	494	
d1, Uniform Delay [s]	57,01	20,75	18,45	72,13	83,00	70,09	
k, delay calibration	0,50	0,50	0,50	0,50	0,50	0,50	
I, Upstream Filtering Factor	1,00	1,00	1,00	1,00	1,00	1,00	
d2, Incremental Delay [s]	65,21	1,85	0,93	7,61	56,79	5,04	
d3, Initial Queue Delay [s]	0,00	0,00	0,00	0,00	0,00	0,00	
Rp, platoon ratio	1,00	1,00	1,00	1,00	1,00	1,00	
PF, progression factor	1,00	1,00	1,00	1,00	1,00	1,00	

Lane Group Results

X, volume / capacity	1,10	0,49	0,37	0,66	1,10	0,59	
d, Delay for Lane Group [s/veh]	122,22	22,60	19,38	79,74	139,79	75,13	
Lane Group LOS	F	C	B	E	F	E	
Critical Lane Group	Yes	No	No	No	Yes	No	
50th-Percentile Queue Length [veh/ln]	55,33	13,96	10,72	16,67	36,65	15,88	
50th-Percentile Queue Length [m/ln]	421,58	106,39	81,70	127,03	279,31	121,00	
95th-Percentile Queue Length [veh/ln]	73,45	20,09	16,09	23,37	49,67	22,41	
95th-Percentile Queue Length [m/ln]	559,72	153,08	122,61	178,06	378,48	170,80	

Movement, Approach, & Intersection Results

d_M, Delay for Movement [s/veh]	0,00	122,22	122,22	22,60	19,38	0,00	79,74	139,79	75,13	0,00	0,00	0,00
Movement LOS		F	F	C	B		E	F	E			
d_A, Approach Delay [s/veh]		122,22			21,10			122,82			0,00	
Approach LOS		F			C			F			A	
d_I, Intersection Delay [s/veh]						99,18						
Intersection LOS						F						
Intersection V/C						1,087						

Other Modes

g_Walk,mi, Effective Walk Time [s]	9,0	9,0	9,0	9,0
M_corner, Corner Circulation Area [m²/ped]	0,00	0,00	0,00	0,00
M_CW, Crosswalk Circulation Area [m²/ped]	0,00	0,00	0,00	0,00
d_p, Pedestrian Delay [s]	111,17	111,17	111,17	111,17
I_p,int, Pedestrian LOS Score for Intersection	2,744	2,959	3,236	3,535
Crosswalk LOS	B	C	C	D
s_b, Saturation Flow Rate of the bicycle lane	2000	2000	2000	2000
c_b, Capacity of the bicycle lane [bicycles/h]	1317	1317	617	0
d_b, Bicycle Delay [s]	14,01	14,01	57,41	120,00
I_b,int, Bicycle LOS Score for Intersection	2,802	2,995	2,736	4,132
Bicycle LOS	C	C	B	D

Sequence

Ring 1	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Ring 2	-	6	-	8	-	-	-	-	-	-	-	-	-	-	-	-
Ring 3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Ring 4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Intersection Level Of Service Report
Intersection 9: Bell St./Henshall St.

Control Type:	Signalized	Delay (sec / veh):	61,1
Analysis Method:	HCM 6th Edition	Level Of Service:	E
Analysis Period:	15 minutes	Volume to Capacity (v/c):	0,958

Intersection Setup

Name	Henshall St.			Henshall St.			Bell St.			Bell St.		
Approach	Northbound			Southbound			Eastbound			Westbound		
Lane Configuration												
Turning Movement	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right
Lane Width [m]	3,70	3,70	3,66	3,66	3,70	3,70	3,66	3,66	3,66	3,70	3,70	3,70
No. of Lanes in Entry Pocket	0	0	0	0	0	0	0	0	0	0	0	1
Entry Pocket Length [m]	30,48	30,48	30,48	30,48	30,48	30,48	30,48	30,48	30,48	30,48	30,48	30,48
No. of Lanes in Exit Pocket	0	0	0	0	0	0	0	0	0	0	0	0
Exit Pocket Length [m]	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
Speed [km/h]	60,00			60,00			48,28			60,00		
Grade [%]	0,00			0,00			0,00			0,00		
Curb Present	No			No						No		
Crosswalk	Yes			Yes			Yes			Yes		

Volumes

Name	Henshall St.			Henshall St.			Bell St.			Bell St.		
Base Volume Input [veh/h]	267	433	0	0	593	104	0	0	0	311	1153	351
Base Volume Adjustment Factor	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000
Heavy Vehicles Percentage [%]	2,00	2,00	2,00	2,00	2,00	2,00	2,00	2,00	2,00	2,00	2,00	2,00
Growth Factor	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000
In-Process Volume [veh/h]	0	0	0	0	0	0	0	0	0	0	0	0
Site-Generated Trips [veh/h]	0	0	0	0	0	0	0	0	0	0	0	0
Diverted Trips [veh/h]	0	0	0	0	0	0	0	0	0	0	0	0
Pass-by Trips [veh/h]	0	0	0	0	0	0	0	0	0	0	0	0
Existing Site Adjustment Volume [veh/h]	0	0	0	0	0	0	0	0	0	0	0	0
Other Volume [veh/h]	0	0	0	0	0	0	0	0	0	0	0	0
Left-Turn on Red Volume [veh/h]	0	0	0	0	0	0	0	0	0	0	0	0
Total Hourly Volume [veh/h]	267	433	0	0	593	104	0	0	0	311	1153	351
Peak Hour Factor	0,9500	0,9500	1,0000	1,0000	0,9500	0,9500	1,0000	1,0000	1,0000	0,9500	0,9500	0,9500
Other Adjustment Factor	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000
Total 15-Minute Volume [veh/h]	70	114	0	0	156	27	0	0	0	82	303	92
Total Analysis Volume [veh/h]	281	456	0	0	624	109	0	0	0	327	1214	369
Presence of On-Street Parking	No		No	No		No				No		No
On-Street Parking Maneuver Rate [/h]	0	0	0	0	0	0	0	0	0	0	0	0
Local Bus Stopping Rate [/h]	0	0	0	0	0	0	0	0	0	0	0	0
v_do, Outbound Pedestrian Volume crossing		0			0			0			0	
v_di, Inbound Pedestrian Volume crossing m		0			0			0			0	
v_co, Outbound Pedestrian Volume crossing		0			0			0			0	
v_ci, Inbound Pedestrian Volume crossing mi		0			0			0			0	
v_ab, Corner Pedestrian Volume [ped/h]		0			0			0			0	
Bicycle Volume [bicycles/h]		0			0			0			0	

Intersection Settings

Located in CBD	Yes
Signal Coordination Group	-
Cycle Length [s]	70
Coordination Type	Time of Day Pattern Coordinated
Actuation Type	Fixed time
Offset [s]	0,0
Offset Reference	Lead Green - Beginning of First Green
Permissive Mode	SingleBand
Lost time [s]	0,00

Phasing & Timing

Control Type	Permiss	Permiss	Permiss	Permiss	Permiss	Permiss	Permiss	Permiss	Permiss	Permiss	Permiss	Permiss
Signal Group	0	6	0	0	2	0	0	0	0	0	4	0
Auxiliary Signal Groups												
Lead / Lag	-	-	-	-	-	-	-	-	-	-	-	-
Minimum Green [s]	0	10	0	0	10	0	0	0	0	0	10	0
Maximum Green [s]	0	30	0	0	30	0	0	0	0	0	30	0
Amber [s]	0,0	3,0	0,0	0,0	3,0	0,0	0,0	0,0	0,0	0,0	3,0	0,0
All red [s]	0,0	1,0	0,0	0,0	1,0	0,0	0,0	0,0	0,0	0,0	1,0	0,0
Split [s]	0	34	0	0	34	0	0	0	0	0	36	0
Vehicle Extension [s]	0,0	3,0	0,0	0,0	3,0	0,0	0,0	0,0	0,0	0,0	3,0	0,0
Walk [s]	0	5	0	0	5	0	0	0	0	0	5	0
Pedestrian Clearance [s]	0	6	0	0	12	0	0	0	0	0	9	0
Delayed Vehicle Green [s]	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Rest In Walk		No			No						No	
I1, Start-Up Lost Time [s]	0,0	2,0	0,0	0,0	2,0	0,0	0,0	0,0	0,0	0,0	2,0	0,0
I2, Clearance Lost Time [s]	0,0	2,0	0,0	0,0	2,0	0,0	0,0	0,0	0,0	0,0	2,0	0,0
Minimum Recall		No			No						No	
Maximum Recall		No			No						No	
Pedestrian Recall		No			No						No	
Detector Location [m]	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Detector Length [m]	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
I, Upstream Filtering Factor	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00

Exclusive Pedestrian Phase

Pedestrian Signal Group	0
Pedestrian Walk [s]	0
Pedestrian Clearance [s]	0

Lane Group Calculations

Lane Group	C	C	C		C	C	R
C, Cycle Length [s]	70	70	70		70	70	70
L, Total Lost Time per Cycle [s]	4,00	4,00	4,00		4,00	4,00	4,00
l1_p, Permitted Start-Up Lost Time [s]	0,00	0,00	2,00		0,00	0,00	0,00
l2, Clearance Lost Time [s]	2,00	2,00	2,00		2,00	2,00	2,00
g_i, Effective Green Time [s]	30	30	30		32	32	32
g / C, Green / Cycle	0,43	0,43	0,43		0,46	0,46	0,46
(v / s)_i Volume / Saturation Flow Rate	0,47	0,41	10000,00		0,49	0,46	0,23
s, saturation flow rate [veh/h]	1577	1532	0		1565	1683	1603
c, Capacity [veh/h]	676	656	103		716	769	733
d1, Uniform Delay [s]	20,00	19,29	35,00		19,00	19,00	13,40
k, delay calibration	0,50	0,50	0,50		0,50	0,50	0,50
I, Upstream Filtering Factor	1,00	1,00	1,00		1,00	1,00	1,00
d2, Incremental Delay [s]	61,87	24,91	105,77		55,21	33,47	2,46
d3, Initial Queue Delay [s]	0,00	0,00	0,00		0,00	0,00	0,00
Rp, platoon ratio	1,00	1,00	1,00		1,00	1,00	1,00
PF, progression factor	1,00	1,00	1,00		1,00	1,00	1,00

Lane Group Results

X, volume / capacity	1,09	0,95	1,06		1,07	1,00	0,50
d, Delay for Lane Group [s/veh]	81,87	44,20	140,77		74,21	52,47	15,86
Lane Group LOS	F	D	F		F	F	B
Critical Lane Group	Yes	No	No		Yes	No	No
50th-Percentile Queue Length [veh/ln]	20,95	12,86	4,69		20,65	17,56	4,02
50th-Percentile Queue Length [m/ln]	159,67	97,97	35,75		157,37	133,79	30,64
95th-Percentile Queue Length [veh/ln]	30,23	18,74	8,44		29,58	24,51	7,24
95th-Percentile Queue Length [m/ln]	230,39	142,78	64,35		225,42	186,74	55,15

Movement, Approach, & Intersection Results

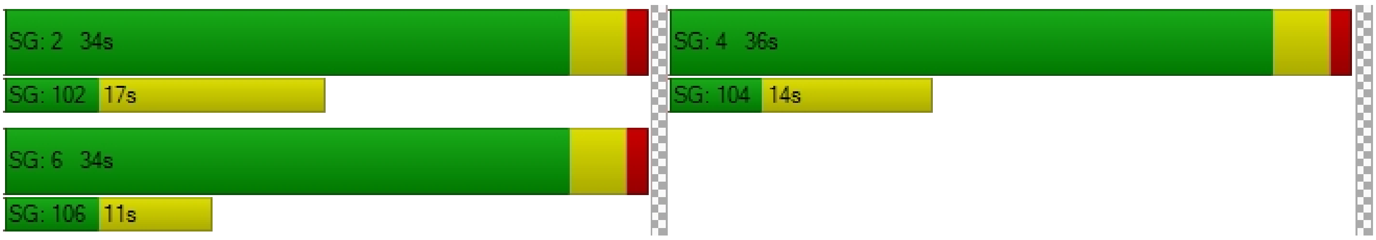
d_M, Delay for Movement [s/veh]	81,87	81,87	0,00	0,00	44,20	140,77	0,00	0,00	0,00	74,21	60,38	15,86
Movement LOS	F	F			D	F				E	E	B
d_A, Approach Delay [s/veh]		81,87			58,56			0,00			54,14	
Approach LOS		F			E			A			D	
d_I, Intersection Delay [s/veh]	61,15											
Intersection LOS	E											
Intersection V/C	0,958											

Other Modes

g_Walk,mi, Effective Walk Time [s]	9,0	9,0	9,0	9,0
M_corner, Corner Circulation Area [m²/ped]	0,00	0,00	0,00	0,00
M_CW, Crosswalk Circulation Area [m²/ped]	0,00	0,00	0,00	0,00
d_p, Pedestrian Delay [s]	26,58	26,58	26,58	26,58
I_p,int, Pedestrian LOS Score for Intersection	3,026	2,942	3,117	3,051
Crosswalk LOS	C	C	C	C
s_b, Saturation Flow Rate of the bicycle lane	2000	2000	2000	2000
c_b, Capacity of the bicycle lane [bicycles/h]	857	857	0	914
d_b, Bicycle Delay [s]	11,43	11,43	35,00	10,31
I_b,int, Bicycle LOS Score for Intersection	2,776	2,164	4,132	3,135
Bicycle LOS	C	B	D	C

Sequence

Ring 1	-	2	-	4	-	-	-	-	-	-	-	-	-	-	-	-
Ring 2	-	6	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Ring 3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Ring 4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-



Intersection Level Of Service Report
Intersection 10: Andrew St/ Henshall St

Control Type:	All-way stop	Delay (sec / veh):	12,2
Analysis Method:	HCM 6th Edition	Level Of Service:	B
Analysis Period:	15 minutes	Volume to Capacity (v/c):	0,511

Intersection Setup

Name	Henshall St.		Andrew St.		Andrew St.	
Approach	Northbound		Eastbound		Westbound	
Lane Configuration						
Turning Movement	Left	Right	Thru	Right	Left	Thru
Lane Width [m]	3,70	3,70	3,70	3,70	3,70	3,70
No. of Lanes in Entry Pocket	0	0	0	1	0	0
Entry Pocket Length [m]	30,48	30,48	30,48	300,00	30,48	30,48
No. of Lanes in Exit Pocket	0	0	0	0	0	0
Exit Pocket Length [m]	0,00	0,00	0,00	0,00	0,00	0,00
Speed [km/h]	60,00		48,28		60,00	
Grade [%]	0,00		0,00		0,00	
Crosswalk	Yes		Yes		Yes	

Volumes

Name	Henshall St.		Andrew St.		Andrew St.	
Base Volume Input [veh/h]	345	45	109	259	14	104
Base Volume Adjustment Factor	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000
Heavy Vehicles Percentage [%]	2,00	2,00	2,00	2,00	2,00	2,00
Growth Factor	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000
In-Process Volume [veh/h]	0	0	0	0	0	0
Site-Generated Trips [veh/h]	0	0	0	0	0	0
Diverted Trips [veh/h]	0	0	0	0	0	0
Pass-by Trips [veh/h]	0	0	0	0	0	0
Existing Site Adjustment Volume [veh/h]	0	0	0	0	0	0
Other Volume [veh/h]	0	0	0	0	0	0
Total Hourly Volume [veh/h]	345	45	109	259	14	104
Peak Hour Factor	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000
Other Adjustment Factor	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000
Total 15-Minute Volume [veh/h]	86	11	27	65	4	26
Total Analysis Volume [veh/h]	345	45	109	259	14	104
Pedestrian Volume [ped/h]	0		0		0	

Intersection Settings

Lanes

Capacity per Entry Lane [veh/h]	763	631	580	650
Degree of Utilization, x	0,51	0,17	0,45	0,18

Movement, Approach, & Intersection Results

95th-Percentile Queue Length [veh]	2,95	0,62	2,29	0,66
95th-Percentile Queue Length [m]	22,48	4,73	17,46	5,02
Approach Delay [s/veh]	12,55	12,57		9,77
Approach LOS	B	B		A
Intersection Delay [s/veh]	12,18			
Intersection LOS	B			

Generated with PTV VISTRO
Version 2021 (SP 0-6)

Intersection Level Of Service Report
Intersection 11: Old Pretoria Rd/ Madiba Dr

Control Type:	Signalized	Delay (sec / veh):	364,9
Analysis Method:	HCM 6th Edition	Level Of Service:	F
Analysis Period:	15 minutes	Volume to Capacity (v/c):	3,047

Intersection Setup

Name	Madiba Dr			Madiba Dr			Old Pretoria Rd			Old Pretoria Rd		
Approach	Northbound			Southbound			Eastbound			Westbound		
Lane Configuration												
Turning Movement	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right
Lane Width [m]	3,70	3,70	3,70	3,70	3,70	3,70	3,70	3,70	3,70	3,70	3,70	3,70
No. of Lanes in Entry Pocket	1	0	1	1	0	1	1	0	1	1	0	1
Entry Pocket Length [m]	50,00	30,48	90,00	100,00	30,48	60,00	50,00	30,48	60,00	60,00	30,48	100,00
No. of Lanes in Exit Pocket	0	0	0	0	0	0	0	0	0	0	0	0
Exit Pocket Length [m]	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
Speed [km/h]	60,00			60,00			60,00			60,00		
Grade [%]	0,00			0,00			0,00			0,00		
Curb Present	No			No			No			No		
Crosswalk	Yes			Yes			Yes			Yes		

Volumes

Name	Madiba Dr			Madiba Dr			Old Pretoria Rd			Old Pretoria Rd		
Base Volume Input [veh/h]	340	1576	99	852	3208	766	886	992	560	373	470	812
Base Volume Adjustment Factor	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000
Heavy Vehicles Percentage [%]	2,00	2,00	2,00	2,00	2,00	2,00	2,00	2,00	2,00	2,00	2,00	2,00
Growth Factor	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000
In-Process Volume [veh/h]	0	0	0	0	0	0	0	0	0	0	0	0
Site-Generated Trips [veh/h]	0	0	0	0	0	0	0	0	0	0	0	0
Diverted Trips [veh/h]	0	0	0	0	0	0	0	0	0	0	0	0
Pass-by Trips [veh/h]	0	0	0	0	0	0	0	0	0	0	0	0
Existing Site Adjustment Volume [veh/h]	0	0	0	0	0	0	0	0	0	0	0	0
Other Volume [veh/h]	0	0	0	0	0	0	0	0	0	0	0	0
Left-Turn on Red Volume [veh/h]	0	0	0	0	0	0	0	0	0	0	0	0
Total Hourly Volume [veh/h]	340	1576	99	852	3208	766	886	992	560	373	470	812
Peak Hour Factor	0,9500	0,9500	0,9500	0,9500	0,9500	0,9500	0,9500	0,9500	0,9500	0,9500	0,9500	0,9500
Other Adjustment Factor	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000
Total 15-Minute Volume [veh/h]	89	415	26	224	844	202	233	261	147	98	124	214
Total Analysis Volume [veh/h]	358	1659	104	897	3377	806	933	1044	589	393	495	855
Presence of On-Street Parking	No		No	No		No	No		No	No		No
On-Street Parking Maneuver Rate [/h]	0	0	0	0	0	0	0	0	0	0	0	0
Local Bus Stopping Rate [/h]	0	0	0	0	0	0	0	0	0	0	0	0
v_do, Outbound Pedestrian Volume crossing	0			0			0			0		
v_di, Inbound Pedestrian Volume crossing m	0			0			0			0		
v_co, Outbound Pedestrian Volume crossing	0			0			0			0		
v_ci, Inbound Pedestrian Volume crossing mi	0			0			0			0		
v_ab, Corner Pedestrian Volume [ped/h]	0			0			0			0		
Bicycle Volume [bicycles/h]	0			0			0			0		

Intersection Settings

Located in CBD	Yes
Signal Coordination Group	-
Cycle Length [s]	100
Coordination Type	Time of Day Pattern Coordinated
Actuation Type	Fixed time
Offset [s]	0,0
Offset Reference	Lead Green - Beginning of First Green
Permissive Mode	SingleBand
Lost time [s]	0,00

Phasing & Timing

Control Type	Permiss	Permiss	Permiss	Permiss	Permiss	Permiss	Permiss	Permiss	Permiss	Permiss	Permiss	Permiss
Signal Group	0	6	0	0	2	0	0	8	0	0	4	0
Auxiliary Signal Groups												
Lead / Lag	-	-	-	-	-	-	-	-	-	-	-	-
Minimum Green [s]	0	10	0	0	10	0	0	10	0	0	10	0
Maximum Green [s]	0	30	0	0	30	0	0	30	0	0	30	0
Amber [s]	0,0	3,0	0,0	0,0	3,0	0,0	0,0	3,0	0,0	0,0	3,0	0,0
All red [s]	0,0	1,0	0,0	0,0	1,0	0,0	0,0	1,0	0,0	0,0	1,0	0,0
Split [s]	0	54	0	0	54	0	0	46	0	0	46	0
Vehicle Extension [s]	0,0	3,0	0,0	0,0	3,0	0,0	0,0	3,0	0,0	0,0	3,0	0,0
Walk [s]	0	5	0	0	5	0	0	5	0	0	5	0
Pedestrian Clearance [s]	0	22	0	0	22	0	0	30	0	0	27	0
Delayed Vehicle Green [s]	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Rest In Walk		No			No			No			No	
I1, Start-Up Lost Time [s]	0,0	2,0	0,0	0,0	2,0	0,0	0,0	2,0	0,0	0,0	2,0	0,0
I2, Clearance Lost Time [s]	0,0	2,0	0,0	0,0	2,0	0,0	0,0	2,0	0,0	0,0	2,0	0,0
Minimum Recall		No			No			No			No	
Maximum Recall		No			No			No			No	
Pedestrian Recall		No			No			No			No	
Detector Location [m]	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Detector Length [m]	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
I, Upstream Filtering Factor	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00

Exclusive Pedestrian Phase

Pedestrian Signal Group	0
Pedestrian Walk [s]	0
Pedestrian Clearance [s]	0

Lane Group Calculations

Lane Group	L	C	R	L	C	R	L	C	R	L	C	R
C, Cycle Length [s]	100	100	100	100	100	100	100	100	100	100	100	100
L, Total Lost Time per Cycle [s]	4,00	4,00	4,00	4,00	4,00	4,00	4,00	4,00	4,00	4,00	4,00	4,00
l1_p, Permitted Start-Up Lost Time [s]	0,00	0,00	2,00	0,00	0,00	2,00	0,00	0,00	2,00	0,00	0,00	2,00
l2, Clearance Lost Time [s]	2,00	2,00	2,00	2,00	2,00	2,00	2,00	2,00	2,00	2,00	2,00	2,00
g_i, Effective Green Time [s]	50	50	50	50	50	50	42	42	42	42	42	42
g / C, Green / Cycle	0,50	0,50	0,50	0,50	0,50	0,50	0,42	0,42	0,42	0,42	0,42	0,42
(v / s)_i Volume / Saturation Flow Rate	0,25	0,36	2,14	0,63	0,74	1,54	0,65	0,33	0,37	0,27	0,15	0,91
s, saturation flow rate [veh/h]	1431	4584	49	1431	4584	524	1431	3204	1577	1431	3204	944
c, Capacity [veh/h]	715	2292	72	715	2292	175	601	1346	536	601	1346	185
d1, Uniform Delay [s]	16,67	19,59	50,00	25,00	25,00	44,22	29,00	24,95	37,27	23,19	19,89	46,34
k, delay calibration	0,50	0,50	0,50	0,50	0,50	0,50	0,50	0,50	0,50	0,50	0,50	0,50
I, Upstream Filtering Factor	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00
d2, Incremental Delay [s]	2,49	2,02	262,02	125,64	215,38	1635,17	256,94	4,43	68,99	5,47	0,78	1641,39
d3, Initial Queue Delay [s]	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
Rp, platoon ratio	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00
PF, progression factor	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00

Lane Group Results

X, volume / capacity	0,50	0,72	1,44	1,25	1,47	4,60	1,55	0,78	1,10	0,65	0,37	4,62
d, Delay for Lane Group [s/veh]	19,17	21,61	312,02	150,64	240,38	1679,39	285,94	29,38	106,27	28,66	20,67	1687,73
Lane Group LOS	B	C	F	F	F	F	F	C	F	C	C	F
Critical Lane Group	No	No	Yes	No	No	No	No	No	No	No	No	Yes
50th-Percentile Queue Length [veh/ln]	5,59	9,68	7,01	40,23	62,02	41,90	56,24	10,81	11,71	7,90	3,92	44,46
50th-Percentile Queue Length [m/ln]	42,62	73,76	53,41	306,57	472,63	319,29	428,56	82,40	89,23	60,21	29,87	338,79
95th-Percentile Queue Length [veh/ln]	9,47	14,78	12,62	59,25	95,34	75,02	87,63	16,21	18,40	12,51	7,06	77,94
95th-Percentile Queue Length [m/ln]	72,17	112,65	96,13	451,49	726,49	571,68	667,77	123,50	140,18	95,34	53,77	593,91

Movement, Approach, & Intersection Results

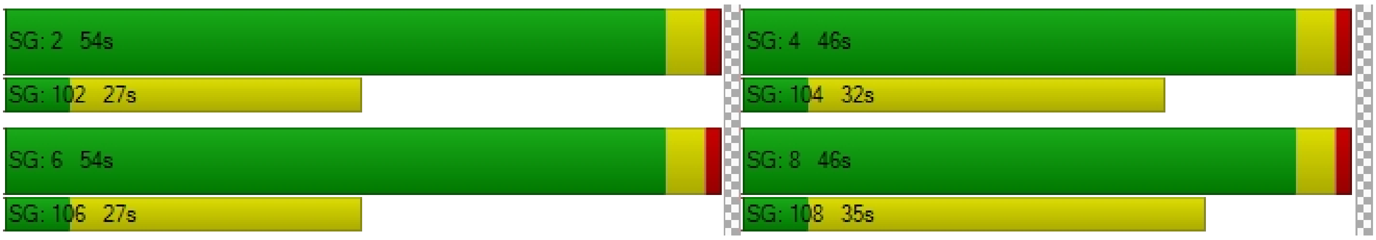
d_M, Delay for Movement [s/veh]	19,17	21,61	312,02	150,64	240,38	1679,39	285,94	29,38	106,27	28,66	20,67	1687,73
Movement LOS	B	C	F	F	F	F	F	C	F	C	C	F
d_A, Approach Delay [s/veh]		35,44			452,85			140,31			840,22	
Approach LOS		D			F			F			F	
d_I, Intersection Delay [s/veh]	364,92											
Intersection LOS	F											
Intersection V/C	3,047											

Other Modes

g_Walk,mi, Effective Walk Time [s]	9,0	9,0	9,0	9,0
M_corner, Corner Circulation Area [m²/ped]	0,00	0,00	0,00	0,00
M_CW, Crosswalk Circulation Area [m²/ped]	0,00	0,00	0,00	0,00
d_p, Pedestrian Delay [s]	41,41	41,41	41,41	41,41
I_p,int, Pedestrian LOS Score for Intersection	5,149	5,920	4,924	3,804
Crosswalk LOS	F	F	E	D
s_b, Saturation Flow Rate of the bicycle lane	2000	2000	2000	2000
c_b, Capacity of the bicycle lane [bicycles/h]	1000	1000	840	840
d_b, Bicycle Delay [s]	12,50	12,50	16,82	16,82
I_b,int, Bicycle LOS Score for Intersection	2,726	4,354	3,677	2,998
Bicycle LOS	B	E	D	C

Sequence

Ring 1	-	2	-	4	-	-	-	-	-	-	-	-	-	-	-	-
Ring 2	-	6	-	8	-	-	-	-	-	-	-	-	-	-	-	-
Ring 3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Ring 4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-



Intersection Level Of Service Report
Intersection 12: Andrew St/ Paul Kruger St

Control Type:	Two-way stop	Delay (sec / veh):	182,2
Analysis Method:	HCM 6th Edition	Level Of Service:	F
Analysis Period:	15 minutes	Volume to Capacity (v/c):	0,300

Intersection Setup

Name	Paul Kruger St.		Old Pretoria Rd		Andrew St.	
Approach	Northbound		Eastbound		Westbound	
Lane Configuration						
Turning Movement	Left	Right	Thru	Right	Left	Thru
Lane Width [m]	3,70	3,70	3,70	3,70	3,70	3,70
No. of Lanes in Entry Pocket	1	0	0	0	0	0
Entry Pocket Length [m]	200,00	30,48	30,48	30,48	30,48	30,48
No. of Lanes in Exit Pocket	0	0	0	0	1	0
Exit Pocket Length [m]	0,00	0,00	0,00	0,00	15,00	0,00
Speed [km/h]	60,00		60,00		60,00	
Grade [%]	0,00		0,00		0,00	
Crosswalk	Yes		Yes		Yes	

Volumes

Name	Paul Kruger St.		Old Pretoria Rd		Andrew St.	
Base Volume Input [veh/h]	476	7	734	347	50	756
Base Volume Adjustment Factor	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000
Heavy Vehicles Percentage [%]	2,00	2,00	2,00	2,00	2,00	2,00
Growth Factor	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000
In-Process Volume [veh/h]	0	0	0	0	0	0
Site-Generated Trips [veh/h]	0	0	0	0	0	0
Diverted Trips [veh/h]	0	0	0	0	0	0
Pass-by Trips [veh/h]	0	0	0	0	0	0
Existing Site Adjustment Volume [veh/h]	0	0	0	0	0	0
Other Volume [veh/h]	0	0	0	0	0	0
Total Hourly Volume [veh/h]	476	7	734	347	50	756
Peak Hour Factor	0,9500	0,9500	0,9500	0,9500	0,9500	0,9500
Other Adjustment Factor	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000
Total 15-Minute Volume [veh/h]	125	2	193	91	13	199
Total Analysis Volume [veh/h]	501	7	773	365	53	796
Pedestrian Volume [ped/h]	0		0		0	

Intersection Settings

Priority Scheme	Stop	Free	Free
Flared Lane			
Storage Area [veh]	0	0	0
Two-Stage Gap Acceptance	No		
Number of Storage Spaces in Median	0	0	0

Movement, Approach, & Intersection Results

V/C, Movement V/C Ratio	0,87	0,30	0,01	0,47	0,00	0,01
d_M, Delay for Movement [s/veh]	25,04	182,18	0,00	13,51	0,00	0,00
Movement LOS	D	F	A	B	A	A
95th-Percentile Queue Length [veh/ln]	3,85	5,47	1,25	2,49	0,00	0,00
95th-Percentile Queue Length [m/ln]	29,34	41,71	9,49	18,98	0,00	0,00
d_A, Approach Delay [s/veh]	27,20		4,33		0,00	
Approach LOS	D		A		A	
d_I, Intersection Delay [s/veh]	7,52					
Intersection LOS	F					

Vistro File: \...\Analysis of intersections in Mbombela.vistro — Scenario 4 2021 PM Peak (without taxis)
Report File: N:\...\4. 2021 PM Peak (without taxis).pdf — 2021/11/02

Turning Movement Volume: Summary

ID	Intersection Name	Northbound		Southbound		Westbound		Total Volume
		Left	Right	Thru	Right	Left	Thru	
1	D2296/ Friedenheim Rd	254	98	473	66	931	699	2521

ID	Intersection Name	Northbound			Southbound			Eastbound			Westbound			Total Volume
		Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	
3	Kragbron Rd/ Timerhout St	95	163	6	19	79	457	457	9	202	14	14	9	1524

ID	Intersection Name	Northbound			Southbound		Eastbound		Westbound		Total Volume
		Left	Thru	Right	Left	Right	Left	Thru	Thru	Right	
6	Bester St/ Corrier St	104	24	172	0	0	74	381	522	18	1295

ID	Intersection Name	Northbound			Southbound			Westbound			Total Volume
		Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	
7	Bester St/ Henshall St.	162	416	183	362	325	142	180	344	279	2393

ID	Intersection Name	Northbound		Southbound		Eastbound			Total Volume
		Thru	Right	Left	Thru	Left	Thru	Right	
8	Samora Machel Dr/ Henshall St.	442	311	465	405	292	1557	290	3762

ID	Intersection Name	Northbound		Southbound		Westbound			Total Volume
		Left	Thru	Thru	Right	Left	Thru	Right	
9	Bell St./Henshall St.	267	433	593	104	311	1153	351	3212

ID	Intersection Name	Northbound		Eastbound		Westbound		Total Volume
		Left	Right	Thru	Right	Left	Thru	
10	Andrew St/ Henshall St	345	45	109	259	14	104	876

ID	Intersection Name	Northbound			Southbound			Eastbound			Westbound			Total Volume
		Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	
11	Old Pretoria Rd/ Madiba Dr	340	1576	99	852	3208	766	886	992	560	373	470	812	10934

Generated with PTV VISTRO

Version 2021 (SP 0-6)

ID	Intersection Name	Northbound		Eastbound		Westbound		Total Volume
		Left	Right	Thru	Right	Left	Thru	
12	Andrew St/ Paul Kruger St	476	7	734	347	50	756	2370

Vistro File: \...\Analysis of intersections in Mbombela.vistro
Report File: N:\...\4. 2021 PM Peak (without taxis).pdf

Scenario 4 2021 PM Peak (without taxis)
2021/11/02

Turning Movement Volume: Detail

ID	Intersection Name	Volume Type	Northbound		Southbound		Westbound		Total Volume
			Left	Right	Thru	Right	Left	Thru	
1	D2296/ Friedenheim Rd	Final Base	254	98	473	66	931	699	2521
		Growth Factor	1,00	1,00	1,00	1,00	1,00	1,00	-
		In Process	0	0	0	0	0	0	0
		Net New Trips	0	0	0	0	0	0	0
		Other	0	0	0	0	0	0	0
		Future Total	**254**	**98**	**473**	**66**	**931**	**699**	**2521**

ID	Intersection Name	Volume Type	Northbound			Southbound			Eastbound			Westbound			Total Volume
			Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	
3	Kragbron Rd/ Timerhout St	Final Base	95	163	6	19	79	457	457	9	202	14	14	9	1524
		Growth Factor	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	-
		In Process	0	0	0	0	0	0	0	0	0	0	0	0	0
		Net New Trips	0	0	0	0	0	0	0	0	0	0	0	0	0
		Other	0	0	0	0	0	0	0	0	0	0	0	0	0
		Future Total	**95**	**163**	**6**	**19**	**79**	**457**	**457**	**9**	**202**	**14**	**14**	**9**	**1524**

ID	Intersection Name	Volume Type	Northbound			Southbound		Eastbound		Westbound		Total Volume
			Left	Thru	Right	Left	Right	Left	Thru	Thru	Right	
6	Bester St/ Corrier St	Final Base	109	25	181	0	0	78	401	549	19	1362
		Growth Factor	0,95	0,95	0,95	0,95	0,95	0,95	0,95	0,95	0,95	-
		In Process	0	0	0	0	0	0	0	0	0	0
		Net New Trips	0	0	0	0	0	0	0	0	0	0
		Other	0	0	0	0	0	0	0	0	0	0
		Future Total	**104**	**24**	**172**	**0**	**0**	**74**	**381**	**522**	**18**	**1295**

ID	Intersection Name	Volume Type	Northbound			Southbound			Westbound			Total Volume
			Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	
7	Bester St/ Henshall St.	Final Base	170	438	193	381	342	149	189	362	294	2518
		Growth Factor	0,95	0,95	0,95	0,95	0,95	0,95	0,95	0,95	0,95	-
		In Process	0	0	0	0	0	0	0	0	0	0
		Net New Trips	0	0	0	0	0	0	0	0	0	0
		Other	0	0	0	0	0	0	0	0	0	0
		Future Total	**162**	**416**	**183**	**362**	**325**	**142**	**180**	**344**	**279**	**2393**

ID	Intersection Name	Volume Type	Northbound		Southbound		Eastbound			Total Volume
			Thru	Right	Left	Thru	Left	Thru	Right	
8	Samora Machel Dr/ Henshall St.	Final Base	442	311	465	405	292	1557	290	3762
		Growth Factor	1,00	1,00	1,00	1,00	1,00	1,00	1,00	-
		In Process	0	0	0	0	0	0	0	0
		Net New Trips	0	0	0	0	0	0	0	0
		Other	0	0	0	0	0	0	0	0
		Future Total	**442**	**311**	**465**	**405**	**292**	**1557**	**290**	**3762**

ID	Intersection Name	Volume Type	Northbound		Southbound		Westbound			Total Volume
			Left	Thru	Thru	Right	Left	Thru	Right	
9	Bell St./Henshall St.	Final Base	267	433	593	104	311	1153	351	3212
		Growth Factor	1,00	1,00	1,00	1,00	1,00	1,00	1,00	-
		In Process	0	0	0	0	0	0	0	0
		Net New Trips	0	0	0	0	0	0	0	0
		Other	0	0	0	0	0	0	0	0
		Future Total	**267**	**433**	**593**	**104**	**311**	**1153**	**351**	**3212**

ID	Intersection Name	Volume Type	Northbound		Eastbound		Westbound		Total Volume
			Left	Right	Thru	Right	Left	Thru	
10	Andrew St/ Henshall St	Final Base	345	45	109	259	14	104	876
		Growth Factor	1,00	1,00	1,00	1,00	1,00	1,00	-
		In Process	0	0	0	0	0	0	0
		Net New Trips	0	0	0	0	0	0	0
		Other	0	0	0	0	0	0	0
		Future Total	**345**	**45**	**109**	**259**	**14**	**104**	**876**

ID	Intersection Name	Volume Type	Northbound			Southbound			Eastbound			Westbound			Total Volume
			Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	
11	Old Pretoria Rd/ Madiba Dr	Final Base	340	1576	99	852	3208	766	886	992	560	373	470	812	10934
		Growth Factor	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	-
		In Process	0	0	0	0	0	0	0	0	0	0	0	0	0
		Net New Trips	0	0	0	0	0	0	0	0	0	0	0	0	0
		Other	0	0	0	0	0	0	0	0	0	0	0	0	0
		Future Total	**340**	**1576**	**99**	**852**	**3208**	**766**	**886**	**992**	**560**	**373**	**470**	**812**	**10934**

ID	Intersection Name	Volume Type	Northbound		Eastbound		Westbound		Total Volume
			Left	Right	Thru	Right	Left	Thru	
12	Andrew St/ Paul Kruger St	Final Base	476	7	734	347	50	756	2370
		Growth Factor	1,00	1,00	1,00	1,00	1,00	1,00	-
		In Process	0	0	0	0	0	0	0
		Net New Trips	0	0	0	0	0	0	0
		Other	0	0	0	0	0	0	0
		Future Total	**476**	**7**	**734**	**347**	**50**	**756**	**2370**

Signal Warrants Report For Intersection 3: Kragbron Rd/ Timerhout St

Warrants Summary

Warrant	Name	Met?
#1	Eight Hour Vehicular Volume	Yes
#2	Four Hour Vehicular Volume	Yes
#3	Peak Hour	Yes

Intersection Warrants Parameters

Major Approaches	S, N
Minor Approaches	E, W
Speed > 40mph	Yes
Population < 10,000	No
Warrant Factor	70%

Warrant Analysis Traffic Volumes

Hour	Major Streets		Minor Streets	
	S	N	E	W
1	264	555	37	668
2	256	538	36	648
3	251	527	35	635
4	235	494	33	595
5	209	438	29	528
6	206	433	29	521
7	203	427	28	514
8	185	389	26	468
9	182	383	26	461
10	180	377	25	454
11	156	327	22	394
12	145	305	20	367
13	143	300	20	361
14	106	222	15	267
15	106	222	15	267
16	74	155	10	187
17	42	89	6	107
18	42	89	6	107
19	24	50	3	60
20	13	28	2	33
21	8	17	1	20
22	3	6	0	7
23	3	6	0	7
24	3	6	0	7

Warrant Analysis by Hour

Hour	Major Streets		Minor Street		Warrant 1 Condition A				Warrant 1 Condition B				Warrant 2	Warrant 3
	Number	Volume	Number	Volume	100%	80%	70%	56%	100%	80%	70%	56%		Condition B
1	2	819	2	668	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes
2	2	794	2	648	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes
3	2	778	2	635	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes
4	2	729	2	595	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes
5	2	647	2	528	Yes	Yes	Yes	Yes	No	No	Yes	Yes	Yes	Yes
6	2	639	2	521	Yes	Yes	Yes	Yes	No	No	Yes	Yes	Yes	Yes
7	2	630	2	514	Yes	Yes	Yes	Yes	No	No	Yes	Yes	Yes	Yes
8	2	574	2	468	No	Yes	Yes	Yes	No	No	No	Yes	Yes	Yes
9	2	565	2	461	No	Yes	Yes	Yes	No	No	No	Yes	Yes	Yes
10	2	557	2	454	No	Yes	Yes	Yes	No	No	No	Yes	Yes	Yes
11	2	483	2	394	No	Yes	Yes	Yes	No	No	No	No	Yes	Yes
12	2	450	2	367	No	No	Yes	Yes	No	No	No	No	Yes	No
13	2	443	2	361	No	No	Yes	Yes	No	No	No	No	Yes	No
14	2	328	2	267	No	No	No	No	No	No	No	No	No	No
15	2	328	2	267	No	No	No	No	No	No	No	No	No	No
16	2	229	2	187	No	No	No	No	No	No	No	No	No	No
17	2	131	2	107	No	No	No	No	No	No	No	No	No	No
18	2	131	2	107	No	No	No	No	No	No	No	No	No	No
19	2	74	2	60	No	No	No	No	No	No	No	No	No	No
20	2	41	2	33	No	No	No	No	No	No	No	No	No	No
21	2	25	2	20	No	No	No	No	No	No	No	No	No	No
22	2	9	2	7	No	No	No	No	No	No	No	No	No	No
23	2	9	2	7	No	No	No	No	No	No	No	No	No	No
24	2	9	2	7	No	No	No	No	No	No	No	No	No	No
Hours Met					7	11	13	13	0	4	7	10	13	11

Warrant 3 Condition A

Orientation	E	W
Total Stopped Delay Per Vehicle on Minor Approach (s)	12,3	27,5
Number of Lanes on Minor Street Approach	1	2
VehicleHours of Stopped Delay on Minor Approach ([h]h:mm)	0:07	5:06
Delay Condition Met	No	Yes
Volume on Minor Street Approach During Same Hour	37	668
High Minor Volume Condition Met	No	Yes
Total Entering Volume on All Approaches During Same Hour	1524	1524
Number of Approaches on Intersection	4	4
Total Volume Condition Met	Yes	Yes
Warrant Met for Approach	No	Yes
Warrant Met for Intersection	**Yes**	

Signal Warrants Report For Intersection 10: Andrew St/ Henshall St

Warrants Summary

Warrant	Name	Met?
#1	Eight Hour Vehicular Volume	No
#2	Four Hour Vehicular Volume	No
#3	Peak Hour	No

Intersection Warrants Parameters

Major Approaches	S, W
Minor Approaches	E
Speed > 40mph	Yes
Population < 10,000	No
Warrant Factor	70%

Warrant Analysis Traffic Volumes

Hour	Major Streets		Minor Streets
	S	W	E
1	390	368	118
2	378	357	114
3	371	350	112
4	347	328	105
5	308	291	93
6	304	287	92
7	300	283	91
8	273	258	83
9	269	254	81
10	265	250	80
11	230	217	70
12	215	202	65
13	211	199	64
14	156	147	47
15	156	147	47
16	109	103	33
17	62	59	19
18	62	59	19
19	35	33	11
20	20	18	6
21	12	11	4
22	4	4	1
23	4	4	1
24	4	4	1

Warrant Analysis by Hour

Hour	Major Streets		Minor Street		Warrant 1 Condition A				Warrant 1 Condition B				Warrant 2	Warrant 3
	Number	Volume	Number	Volume	100%	80%	70%	56%	100%	80%	70%	56%		Condition B
1	2	758	1	118	No	No	Yes	Yes	No	Yes	Yes	Yes	Yes	No
2	2	735	1	114	No	No	Yes	Yes	No	Yes	Yes	Yes	Yes	No
3	2	721	1	112	No	No	Yes	Yes	No	Yes	Yes	Yes	Yes	No
4	2	675	1	105	No	No	Yes	Yes	No	No	Yes	Yes	No	No
5	2	599	1	93	No	No	No	Yes	No	No	No	Yes	No	No
6	2	591	1	92	No	No	No	Yes	No	No	No	Yes	No	No
7	2	583	1	91	No	No	No	Yes	No	No	No	Yes	No	No
8	2	531	1	83	No	No	No	No	No	No	No	Yes	No	No
9	2	523	1	81	No	No	No	No	No	No	No	Yes	No	No
10	2	515	1	80	No	No	No	No	No	No	No	Yes	No	No
11	2	447	1	70	No	No	No	No	No	No	No	No	No	No
12	2	417	1	65	No	No	No	No	No	No	No	No	No	No
13	2	410	1	64	No	No	No	No	No	No	No	No	No	No
14	2	303	1	47	No	No	No	No	No	No	No	No	No	No
15	2	303	1	47	No	No	No	No	No	No	No	No	No	No
16	2	212	1	33	No	No	No	No	No	No	No	No	No	No
17	2	121	1	19	No	No	No	No	No	No	No	No	No	No
18	2	121	1	19	No	No	No	No	No	No	No	No	No	No
19	2	68	1	11	No	No	No	No	No	No	No	No	No	No
20	2	38	1	6	No	No	No	No	No	No	No	No	No	No
21	2	23	1	4	No	No	No	No	No	No	No	No	No	No
22	2	8	1	1	No	No	No	No	No	No	No	No	No	No
23	2	8	1	1	No	No	No	No	No	No	No	No	No	No
24	2	8	1	1	No	No	No	No	No	No	No	No	No	No
Hours Met					0	0	4	7	0	3	4	10	3	0

Warrant 3 Condition A

Orientation	E
Total Stopped Delay Per Vehicle on Minor Approach (s)	9,8
Number of Lanes on Minor Street Approach	1
VehicleHours of Stopped Delay on Minor Approach ([h]h:mm)	0:19
Delay Condition Met	No
Volume on Minor Street Approach During Same Hour	118
High Minor Volume Condition Met	Yes
Total Entering Volume on All Approaches During Same Hour	876
Number of Approaches on Intersection	3
Total Volume Condition Met	Yes
Warrant Met for Approach	No
Warrant Met for Intersection	**No**

Signal Warrants Report For Intersection 12: Andrew St/ Paul Kruger St

Warrants Summary

Warrant	Name	Met?
#1	Eight Hour Vehicular Volume	Yes
#2	Four Hour Vehicular Volume	Yes
#3	Peak Hour	Yes

Intersection Warrants Parameters

Major Approaches	E, W
Minor Approaches	S
Speed > 40mph	Yes
Population < 10,000	No
Warrant Factor	70%

Warrant Analysis Traffic Volumes

Hour	Major Streets		Minor Streets
	E	W	S
1	806	1081	483
2	782	1049	469
3	766	1027	459
4	717	962	430
5	637	854	382
6	629	843	377
7	621	832	372
8	564	757	338
9	556	746	333
10	548	735	328
11	476	638	285
12	443	595	266
13	435	584	261
14	322	432	193
15	322	432	193
16	226	303	135
17	129	173	77
18	129	173	77
19	73	97	43
20	40	54	24
21	24	32	14
22	8	11	5
23	8	11	5
24	8	11	5

Warrant Analysis by Hour

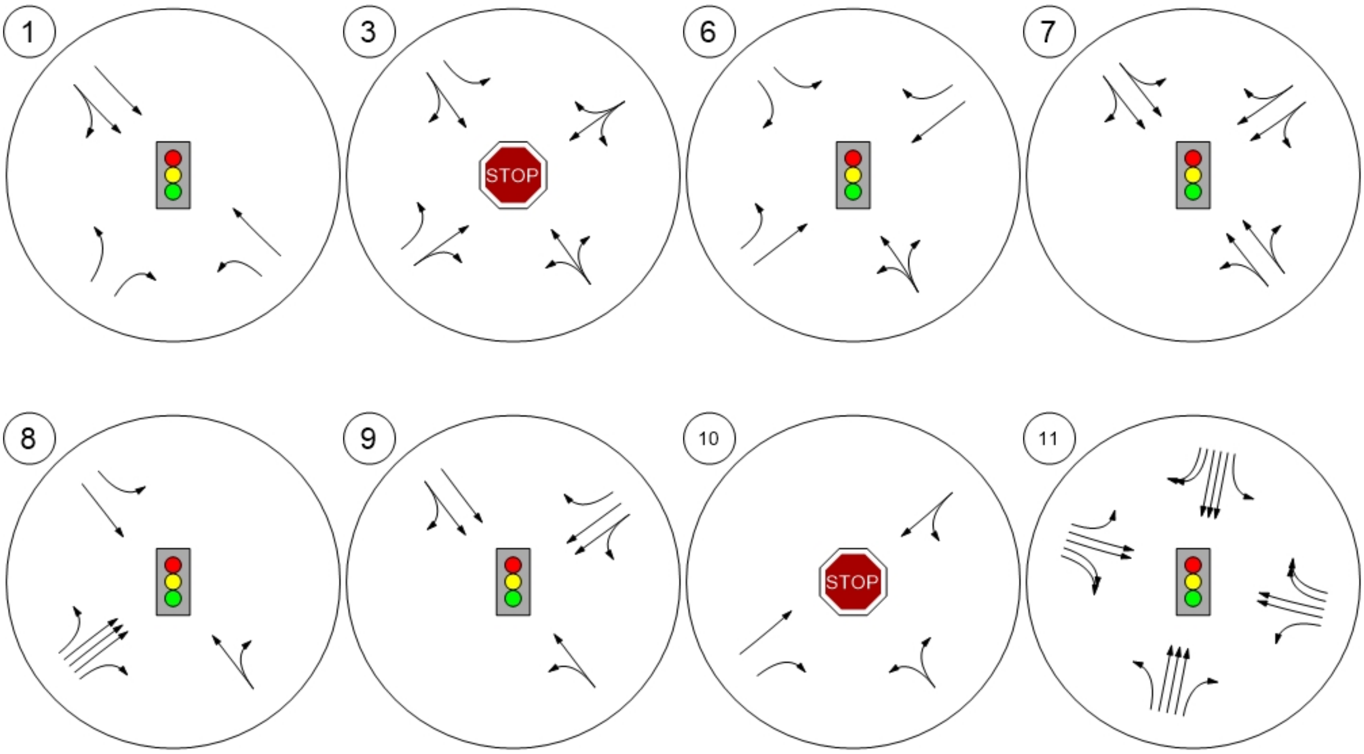
Hour	Major Streets		Minor Street		Warrant 1 Condition A				Warrant 1 Condition B				Warrant 2	Warrant 3
	Number	Volume	Number	Volume	100%	80%	70%	56%	100%	80%	70%	56%		Condition B
1	2	1887	2	483	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
2	2	1831	2	469	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
3	2	1793	2	459	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
4	2	1679	2	430	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
5	2	1491	2	382	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
6	2	1472	2	377	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
7	2	1453	2	372	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
8	2	1321	2	338	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
9	2	1302	2	333	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
10	2	1283	2	328	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
11	2	1114	2	285	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
12	2	1038	2	266	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
13	2	1019	2	261	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
14	2	754	2	193	No	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes	No
15	2	754	2	193	No	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes	No
16	2	529	2	135	No	No	No	Yes	No	No	No	Yes	No	No
17	2	302	2	77	No	No	No	No	No	No	No	No	No	No
18	2	302	2	77	No	No	No	No	No	No	No	No	No	No
19	2	170	2	43	No	No	No	No	No	No	No	No	No	No
20	2	94	2	24	No	No	No	No	No	No	No	No	No	No
21	2	56	2	14	No	No	No	No	No	No	No	No	No	No
22	2	19	2	5	No	No	No	No	No	No	No	No	No	No
23	2	19	2	5	No	No	No	No	No	No	No	No	No	No
24	2	19	2	5	No	No	No	No	No	No	No	No	No	No
Hours Met					13	15	15	16	13	15	15	16	15	13

Warrant 3 Condition A

Orientation	S
Total Stopped Delay Per Vehicle on Minor Approach (s)	27,2
Number of Lanes on Minor Street Approach	2
VehicleHours of Stopped Delay on Minor Approach ([h]h:mm)	3:38
Delay Condition Met	No
Volume on Minor Street Approach During Same Hour	483
High Minor Volume Condition Met	Yes
Total Entering Volume on All Approaches During Same Hour	2370
Number of Approaches on Intersection	3
Total Volume Condition Met	Yes
Warrant Met for Approach	No
Warrant Met for Intersection	**No**

Study Intersections

Lane Configuration and Traffic Control



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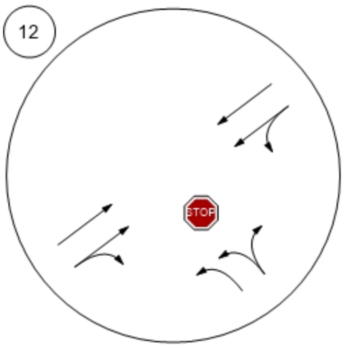
Lane Configuration and Traffic Control



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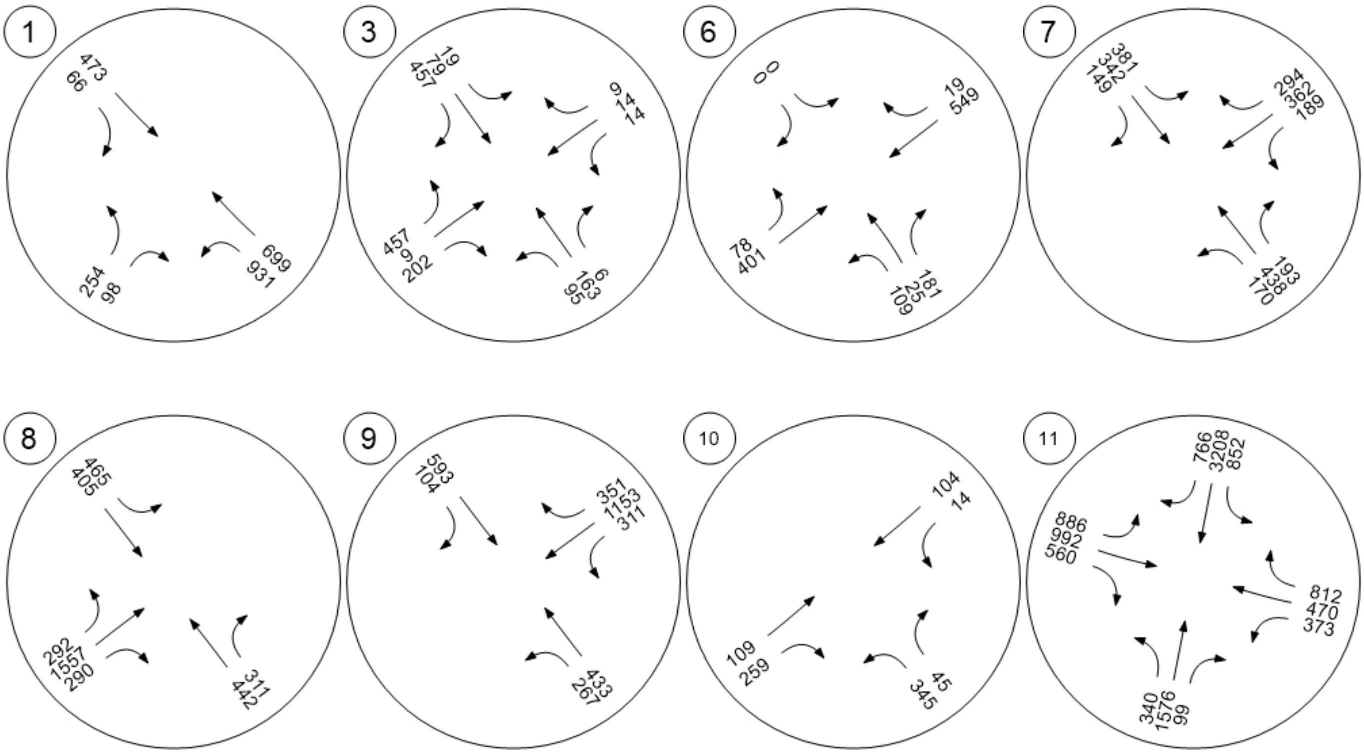
Traffic Volume - Base Volume



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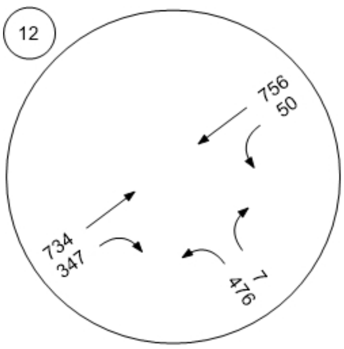
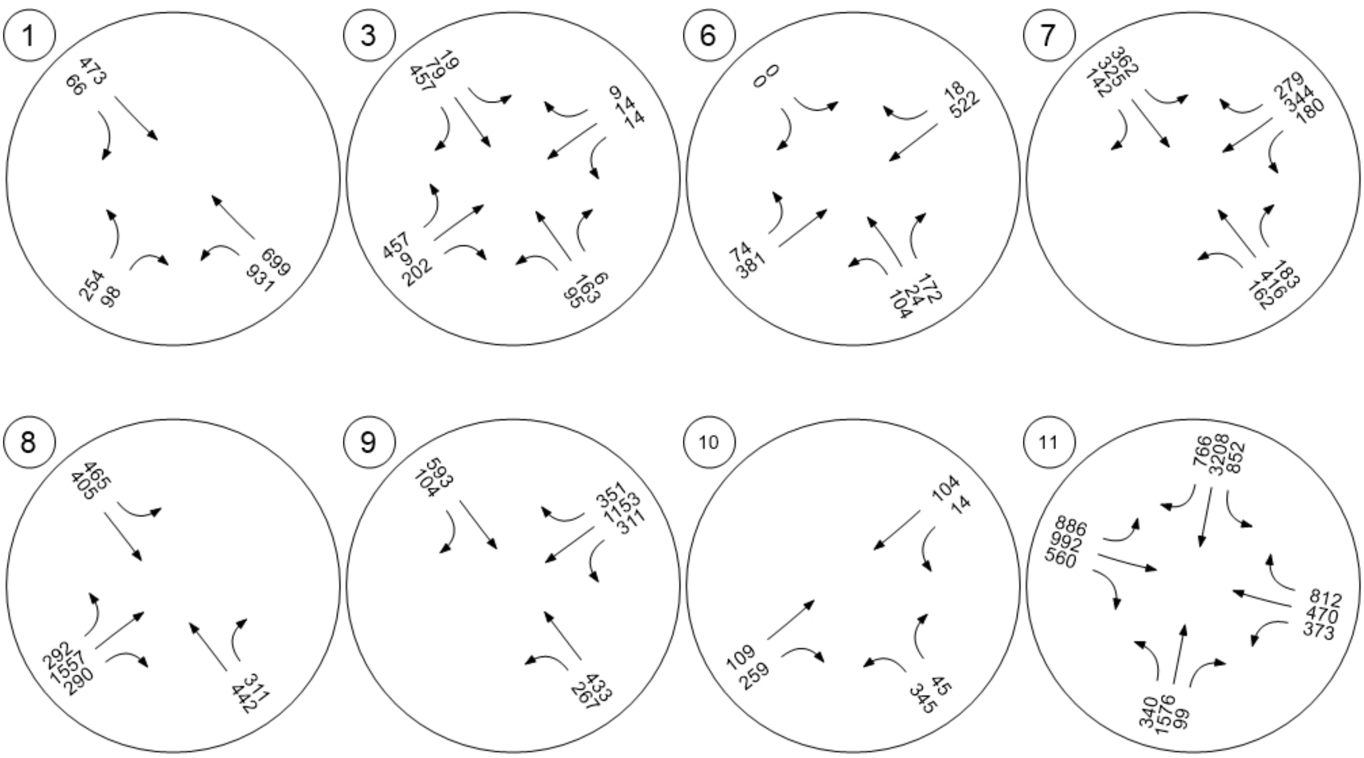
Traffic Volume - Base Volume



Traffic Volume - Future Total Volume



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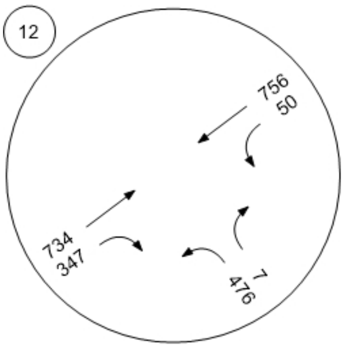
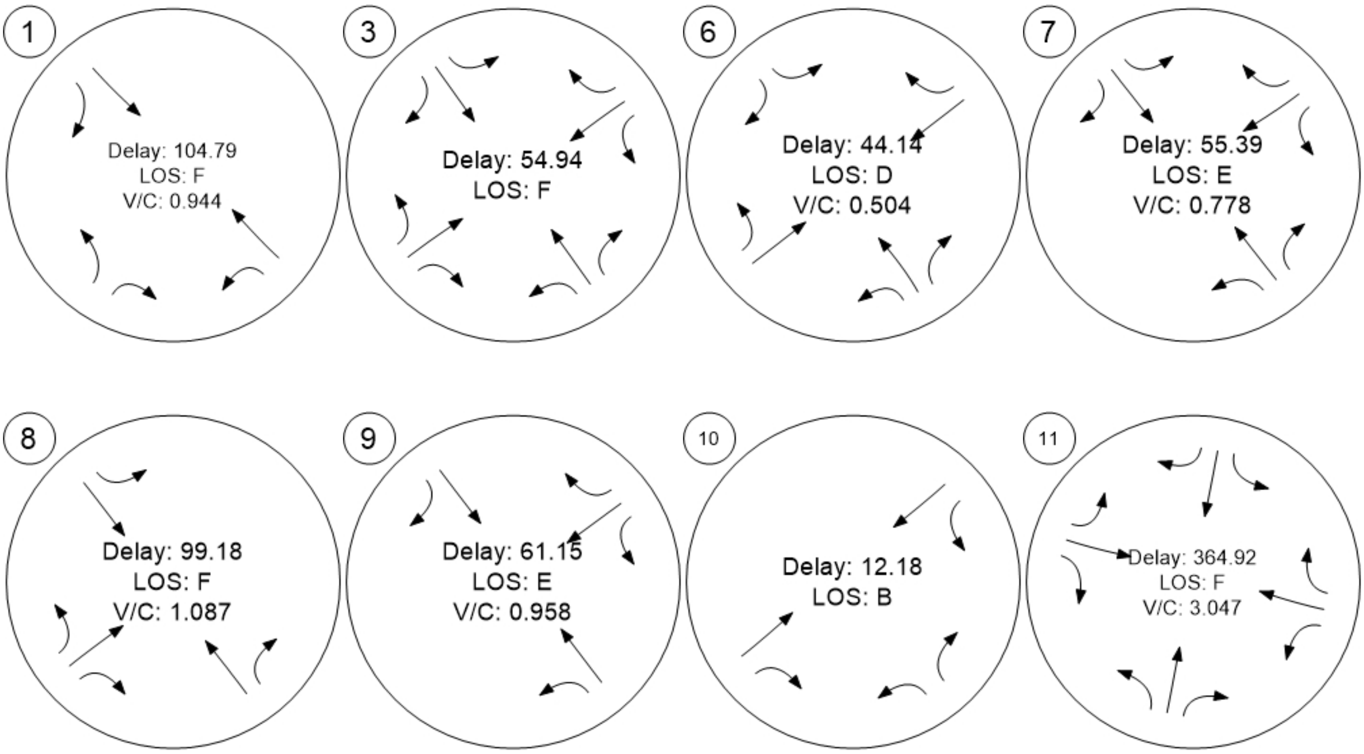
Traffic Volume - Future Total Volume



Traffic Conditions



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Traffic Conditions